



2020

City of Englewood  
1000 Englewood Parkway  
Englewood, CO 80110  
[www.engagewoodgov.org](http://www.engagewoodgov.org)

# ENGLEWOOD STORM DRAINAGE CRITERIA MANUAL



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# **FINAL DRAFT (FEBRUARY, 2020)**

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# **SECTION 1.0 INTRODUCTION**

## **1.1 TITLE**

This Manual together with all future amendments shall be known as the City of Englewood Storm Drainage Criteria Manual, hereinafter called the Manual.

## **1.2 PURPOSE**

The purpose of the Manual is to provide minimum standards to safeguard the health, property and public welfare through the proper control and handling of storm drainage flows and discharge.

This Manual is intended to establish similarity and consistency for the design, presentation, and review of storm drainage improvements within the City of Englewood, Colorado. The design guidelines contained in this Manual are intended for use as engineering guides in the solution of drainage problems. Following the principles and practices, stated within, should facilitate the design, submittal, and review process. The standards and specifications contained within are intended to provide a consistent, adequate, and coordinated approach for dealing with drainage issues in order to serve and protect the people who benefit from these facilities.

The criteria contained in this document provide adopted standards for the more frequent construction and development issues. It is impossible to provide standards for every issue, so good engineering judgment will be required when issues arise that are not addressed in this Manual.

The questions to be considered by the designer and the reviewer when encountering these situations shall be:

- ☐ Will the safety of the affected property owners adjacent to and downstream from the proposed facilities be enhanced or maintained?
- ☐ Will the intended purposes for the proposed improvements be met?
- ☐ Will the operating and maintenance costs be kept at reasonable levels?
- ☐ Will the installation costs be kept at reasonable levels?
- ☐ Will the proposed construction be compatible with surrounding existing and proposed improvements?

## **1.3 AMENDMENTS**

The policies and criteria presented herein are basic guidelines which may be amended in the future as new technology is developed, or as new regulations are adopted, and/or as experience gained in the use of this document indicate a need for revision. Amendments will be applicable to all drainage studies submitted after the effective date of amendment. However, final drainage reports which are submitted for approval within sixty days after the effective date of amendment and which have prior approval of a preliminary drainage report are exempt from the amendments.

## **1.4 AUTHORITY**

### **1) General**

A municipality's inherent police powers enable it to enact ordinances that serve the public's health safety, and general welfare. These regulations together with future amendments have been adopted as the Englewood Storm Drainage Criteria Manual pursuant to the City of Englewood Municipal Code, Title 12 – Chapter 5, titled "The Englewood Storm Water Utility and Enterprise Fund".

### **Failure to Comply**

It shall be deemed a nuisance to fail to comply with any provision of the Englewood Drainage Criteria Manual. Any person, corporation, partnership, or other entity violating any provision of the Manual shall be subject to Title 15 of the Englewood Municipal Code.

3) Stop Work Orders

Whenever any work is being performed contrary to any provision of the Manual, the Public Works Director or designee may order the work stopped by notice in writing served on any person engaged in doing or causing such work. Any person shall forthwith stop such work until authorized by the Director of Public Works or designee in writing to proceed with the work. It is unlawful to do or perform any work in violation of such stop order.

4) MHFD

It is recognized that certain projects financed wholly or in part with county, state, Mile High Flood District (MHFD), or federal funds may be subject to standards prescribed by those agencies. Such standards may be greater or less than the City of Englewood standards.

5) Variances

Variances will be considered on a case-by-case basis. Whenever there are practical difficulties involved in carrying out the provisions of the Manual, the Public Works Director may grant variances for individual cases, provided that the Public Works Director shall first find that special circumstances make these procedures impractical and that the variance is in conformance with the intent and purpose of the Manual, and providing that such variance does not lessen the intent of the design requirement or the level of safety, service and quality intended by the Manual.

The Public Works Director shall require that sufficient evidence or proof be submitted to substantiate any variance request.

If upon review and denial of any variance request, the Developer or Design Engineer may appeal to City of Englewood Water and Sewer Board.<sup>1</sup>

## **1.5 DRAINAGE LAW**

Drainage engineering and design revolves around drainage law as well as the physical laws of gravity and nature. A summary of the general principles of Colorado drainage law made by the courts as well as the legislature have been summarized in the current UDSCM (Volume 1 – Drainage Law).

## **1.6 PERMITS**

Depending on the type of construction, type of improvement, and location of work, different permits will be required to complete the project. The following is a list of possible (but not necessarily a complete list of) permits required by concerned organizations:

**City of Englewood:**

- ❑ Building and Safety Division
  - Building Permit
  - Demolition Permit
- ❑ Department of Community Development
  - Floodplain Zoning Permit
  - Floodplain Development Permit
- ❑ Department of Public Works
  - Right-of-Way Permits
    - Public ROW Excavation Permit
    - Public ROW Concrete Permit

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<sup>1</sup> All appeals regarding floodplain or floodway issues must be made to the Planning and Zoning Commission.  
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- Grading, Erosion, Sediment Control Permit

**State of Colorado:**

- Colorado Department of Transportation
  - Utility Permit
- Colorado Department of Health and Environment
  - Stormwater Discharge Permit

**United States:**

- Army Corp of Engineers
  - 404 Permit to Disturb Wetlands

## 1.7 DEFINITIONS AND ABBREVIATIONS

The following list contains some of the technical terms and abbreviations used in this Manual:

**404 Permit** – A permit under Section 404 of the Federal Clean Water Act that is required for any activities impacting “waters of the United States and jurisdictional wetlands” from the U.S. Army Corps of Engineers.

**A** – Area

**Ac** – Acres

**Base Flood** – The flood caused by a 100-year storm event.

**BFE** - Base Flood Elevation—the water surface elevation for the 100-year flood.

**BMPs** – Best Management Practices – physical, structural, nonstructural, and/or managerial practices that are intended to prevent, mitigate, or reduce pollution of stormwater.

**C** – Coefficient of runoff that is a factor of the percentage of the impervious area and antecedent moisture conditions as used in the rational equation.

**CCR** – Colorado Code of Regulations

**CRS** – Colorado Revised Statutes

**cfs** – Flow rate of water measured in cubic feet per second.

**C<sub>i</sub>** - Percent of impervious area

**City** – City of Englewood, Colorado, and its agents, representatives, and employees acting on its behalf.

**CDOT** – Colorado Department of Transportation

**CDPS** – Colorado Discharge Permit System – Colorado’s version of the NPDES program.

**CLOMR** – Conditional Letter of Map Revision

**COE** – US Army Corp of Engineers

**Construction Activity**-Applicable construction activities include the land disturbing activity and all activities and materials associated with construction site and located at, or contiguous to, the land disturbing activities. Refers to ground surface disturbing and associated activities (land disturbance), which include, but are not limited to, clearing, grading, excavation, demolition, installation of new or improved haul roads and access roads, staging areas, stockpiling of fill materials, and borrow areas. Construction does not include routine maintenance to maintain the original line and grade, hydraulic capacity, or original purpose of the facility. Repaving activities where underlying and/or surrounding soil is cleared, graded, or excavated as part of the repaving operation are considered construction activities. Construction activity is from initial ground breaking to final stabilization regardless of ownership of the construction activities. The WQCD

has determined that “contagious” means construction activities located in close proximity to each other (within ¼ mile).

**Contractor** – A person, partnership, corporation, or other legal entity who undertakes to construct, install, alter, move, remove, trim, demolish, repair, replace, excavate, or add to any improvements covered by this Manual, or any utility, or any other facility that requires work, workers, and/or equipment in the process of performing the above named operations.

**CMP** – Corrugated Metal Pipe

**CMPA** – Corrugated Metal Pipe Arch

**CUHP** – Colorado Urban Hydrograph Procedure

**CWB** – Constructed Wetlands Basin

**CWC** – Constructed Wetlands Channel

**CWCB** – Colorado Water Conservation Board

**CWQCD** – Colorado Department of Health and Environment, Colorado Water Quality Control Division

**D** – Depth (measured in feet)

**d** – Diameter of pipe (measured in inches)

**d<sub>50</sub>** - Mean particle or stone size (identified by diameter or dimension), where the mean is determined by weight.

**Design Engineer or Engineer** – The engineer or corporation developing the engineering studies and designs that are covered by this Manual for a proposed development or improvement of property.

**Developer** – The person, partnership, corporation, or other legal entity who is proposing changes to a parcel of land within the City and who is legally responsible for the construction of the improvements.

**Development** – Any manmade change to an improved or unimproved parcel of land, including but not limited to buildings, other structures, dredging, filling, grading, paving, or excavations.

**dh** – Hydraulic Depth = (area/top width), as used in channel flow analysis

**DRCOG** – Denver Regional Council of Governments

**EC** – Elevation Certificate

**EDB** – Extended Detention Basin

**EGL** – Energy Grade Line—The total energy level of the water. It is the sum of the velocity head, pressure head and the elevation of the water surface.

**E.M.C.** – City of Englewood Municipal Code

**E<sub>o</sub>** – Ratio of the flow in the depressed gutter section to the total flow.

**EPA** – Environmental Protection Agency

**Erodibility** – The susceptibility of a particular soil type to erosion by water or wind.

**Erosion** – The wearing away of soil or rock fragments by water, wind, or other geological agents.

**Erosion Control Measures** – Practices that slow or stop erosion.

**ET** – Evapotranspiration

**Excess Urban Runoff Volume (EURV)** – The difference between the developed condition and pre-development runoff volumes. The runoff volume that results from approximately a 10% chance rainfall event. This volume includes the WQCV.

**FEMA** – Federal Emergency Management Agency

**FHBM** – Flood Hazard Boundary Map

**FHAD** – Flood Hazard Area Delineation

**Final Stabilization** – Completion of all land disturbing activities, removal of all temporary sediment controls, establishment of vegetative cover on exposed soil areas, and installation of permanent improvements and stormwater BMPs.

**FIRM** – Federal Insurance Rate Map – The official map on which FEMA delineates flood hazard areas and risk zones.

**Flood** – A general and temporary condition of partial or complete inundation of normally dry land areas from the unusual and rapid accumulation of runoff of surface water from upstream areas.

**Floodplain** – The lowland area which may be temporarily covered by floodwaters attributed to the accumulation of storm runoff from adjoining or upstream areas in major storm events where special regulations have been adopted in order to protect the public, minimize flood damage and the need for rescue and relief efforts.

**Floodplain Administrator** – Director of Community Development or authorized representative

**Floodway** – The channel of a river or watercourse and the adjacent land area that must be reserved in order to discharge the Base Flood. Encroachments into the floodway area are prohibited.

**ft** – Feet

**fps** – Velocity measurement (feet per second)

**Freeboard** – A factor of safety usually expressed in feet above a certain water-surface elevation.

**Froude Number** – A ratio used to determine whether the flow in an open channel or covered conduit with a free water surface is at critical velocity or equal to 1.0. Flow at or near the critical state (1.0) is not stable and must be avoided.

**Full Spectrum Detention** – A stormwater detention facility design that provides water quality and flood control benefits and reduces impacts on downstream channels by detaining the Excess Urban Runoff Volume (EURV) and releasing it over a 72-hour period.

**g** – Rate of gravitational acceleration (32.2 fps/s)

**GB** – Grass Buffer

**General Permit** – A permit issued by the State Department of Public Health and Environment, Water Quality Control Division that authorizes discharges in compliance with the Clean Water Act, and authorizes activities and programs designed to reduce or prevent pollution of State Waters.

**GIS** – Geographical Information System

**GS** – Grass Swale

**HERCP** – Horizontal Elliptical Reinforced Concrete Pipe

**Historic** – May mean “existing conditions” prior to redevelopment or change in use, when adequate capacity in the existing drainage stormwater system exists; otherwise it shall mean the conditions that existed prior to any development or improvements made to the property.



**HGL** – Hydraulic Grade Line—The profile of the hydrostatic pressure of water as it flows through pipes; it represents the sum of the depth of flow and the pressure head.

**Hydraulic Radius** – Flow in channels are affected by the boundary roughness. To calculate - the actual perimeter of channel in contact with the fluid is divided into the area of the flowing fluid gives the hydraulic radius which is a major component in using Manning's Equations to solve for uniform flow in open channels.

**I** – Rainfall intensity expressed in inches per hour.

**in.** – Inches

**Inspector** – The authorized representative of the Public Works Director assigned to make detailed inspection of construction work to assure compliance with this Manual and the approved plans. approved by the City.

**iph** – Soil infiltration rate expressed in (inches per hour).

**Levee** – A manmade structure designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

**Land Disturbing Activity** – Any activity that results in a change in the existing land surface (both vegetative and non-vegetative). Land disturbing activities include, but are not limited to clearing, grading, excavation, demolition, installation of new or improved haul roads and access roads, staging areas, stockpiling of fill materials, and borrow areas. Compaction that is associated with stabilization of structures and road construction shall also be considered a land disturbing activity.

**Lowest Floor** – The lowest enclosed habitable area of a building.

**LOMA** – Letter of Map Amendment

**LOMR** – Letter of Map Revision

**Major Channel** – Any channel or drainageway with 100 cfs or greater flow.

**Manual** – City of Englewood Drainage Criteria Manual

**Manning's Equation** – 
$$Q = \frac{1.49 * a^{2/3} * R_h^{1/2} * S}{n}$$

**may** – To be interpreted as can or able, or more permissive than the use of “shall” in this Manual.

**MBP** – Modular Block Porous Pavement

**MDCIA** – Minimizing Directly Connected Impervious Areas. The practice of routing concentrated flows from impervious areas over grassy areas to promote infiltration and slow down runoff.

**MEP** – Maximum Extent Practicable – the standard for evaluating permit compliance.

**Minor Development** – Developments that involve little change to existing drainage patterns. By definition therefore they must exhibit the following properties:

- Minor amount of grading work,
- Insignificant increase in runoff generated,
- Development actually improves drainage conditions,
- No additional runoff will be directed to adjacent private properties,
- Stormwater pollution is not currently a problem,

- And Development will not increase the potential for stormwater pollution.

**MH** – Manhole

**MHFD** – Mile High Flood District (formerly known as the Urban Drainage and Flood Control District)

**MS4** – Municipal Separate Storm Sewer System

**n** – Manning’s n, which is a friction factor, assigned to the surface that the liquid is traveling over or through.

**Nf** – Froude Number =  $v / \sqrt{(g * dh)}$

**NFIP** – National Flood Insurance Program

**NOAA** – National Oceanic & Atmospheric Administration

**Nonstructural BMPs** – Policies and practices and improvements designed to *prevent or minimize* the migration of pollutants into receiving waters.

**NPDES** – National Pollutant Discharge Elimination System – Section 402 of the Federal Clean Water Act.

**NRCS** – Natural Resource Conservation Service

**Owner or Property Owner** – Any individual, corporation, partnership, or other legal entity holding controlling title on property which is in some way impacted or involved by development or improving the property.

**P** – wetted perimeter used in finding the hydraulic radius.

**PE** – Professional Engineer licensed in the State of Colorado

**PLD** – Porous Landscape Detention

**PLS** – Professional Land Surveyor licensed in the State of Colorado

**PPD** – Porous Pavement Detention

**Public Improvements** – Improvements in the public way or in easements that are either in the control of (or ownership by) the City.

**Public Works Director** – The City of Englewood Public Works Director or authorized representative.

**Q** – Flow in cfs

**Rh** – Hydraulic Radius =  $a/P$

**RCBC** – Reinforced Concrete Box Culvert

**RCP** – Reinforced Concrete Pipe

**Record Drawings** – The as-constructed drawings for all drainage improvements certified by a PE.

**Redevelopment** – Includes a site that is already substantially developed and has 35% or more of existing hard surface coverage, the creation or addition of hard surfaces; the expansion of a building footprint or addition or replacement of a structure; structural development including construction, installation or expansion of a building or other structure, replacement of hard surface that is not part of a routine maintenance activity; and land disturbing activities.

**Regulation 61** – Colorado Discharge Permit System Regulations – includes stormwater regulations, (5 CCR 1002-61).

**Responsible Party** – Any individual, corporation, partnership, or other legal entity involved in developing improvements or maintaining BMPs covered by this Manual. Includes subcontractors, contractors, developers, and owners, as applicable in the development process.

**ROW – Right-of-Way** – The total surface area, and the area above and below the surface that is dedicated, deeded, reserved by, plat or otherwise owned or controlled by the City, for public use for: infrastructure improvements, pedestrians, vehicular movement, parks, utilities, or storm drainage and runoff.

**RP** – Retention Pond

**S** – Slope of the ground or conveyance element in ft/ft or percent.

**SCS** – Soil Conservation Service, now it is an agency of the United States Department of Agriculture and called Natural Resources Conservation Service.

**SFB** – Sand Filter Extended Detention Basin

**shall** – An obligation or necessity to be interpreted as mandatory.

**should** – Advisory or recommendation, but not mandatory.

**Specifications** – Applicable specifications of agencies or organizations identified and shall mean the latest edition or as revised.

**SPP** - Structural Plate Pipe

**SPPA** - Structural Plate Pipe Arch

**Standards and Specifications** – The “Engineering and Construction Standards and Specifications” of the City of Englewood.

**State Waters** – Any and all surface and subsurface waters which are contained in or flow through the state of Colorado, except for waters in sewage systems or waters in potable water distribution systems.

**Structural BMP** – Facilities *constructed to passively treat* urban stormwater runoff before it enters the receiving waters. These facilities serve as stormwater quality treatment devices.

**Substantial Conformance** – No variation from the approved plans, other than minor changes as determined by the City of Englewood.

**SWMP** – Stormwater Management Plan, for the purposes of this Manual SWMPs are the Construction BMPs that deal with erosion control, sediment control, and drainageway protection.

**T** – Total spread of the water in the gutter and street in feet.

**TMDL** – Total Maximum Daily Load – the amount of a specific pollutant that a listed water body can assimilate without violating applicable water quality standards.

**UBC** – Uniform Building Code

**UDFCD** – Urban Drainage and Flood Control District, now Mile High Flood District

**USBR** – United States Bureau of Reclamation

**USDA** – United States Department of Agriculture

**USDCM** – Urban Storm Drainage Criteria Manual

**USGS** – United States Geological Survey

**v** – Average velocity of flow in fps



**Wetlands** – Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support vegetation typically adapted for life in saturated soil conditions.

**WIR** – Watershed Inches of Runoff

**WQCV** – Water Quality Capture Volume

## **1.8 REFERENCES**

The primary references for this document are the “Urban Storm Drainage Criteria Manual” (USDCM) by the Mile High Flood District, the City and County of Denver, “Storm Drainage Design & Technical Criteria Manual, the City of Lakewood, “Storm Drainage Criteria Manual”, and the Greenwood Village, “Drainage Criteria Manual.” Where specifically referenced, the guidelines and criteria of the referenced manuals shall become a part of this Manual. All manuals and criteria referenced in this Manual shall pertain to the most recent edition.

The following references were used in developing this Manual:

City of Englewood, “Construction Standards and Concrete Specifications”. Englewood, Colorado, revised April 1997.

City of Englewood, “Wastewater Collection Systems, Design and Construction”. Englewood, Colorado.

City of Greenwood Village, “Storm Drainage Criteria Manual”. Greenwood Village, Colorado, April 1999 and February 2019

City of Lakewood, “Storm Drainage Criteria Manual”. Lakewood, Colorado, August 1982.

City of Littleton, “Storm Drainage Design and Technical Criteria”. Littleton, Colorado, July 2019.

City and County of Denver, “Storm Drainage and Technical Criteria”. Denver, Colorado, November 2013.

Code of Colorado Regulations, Colorado Discharge Permit System, (5 CCR 1002-61)

Colorado Department of Transportation, “Drainage Design Manual”, Draft. July 1994.

Sellards & Grigg, Inc., “Storm Drainage Plan”. Englewood, Colorado, January 1971.

Urban Drainage & Flood Control District, “Urban Storm Drainage Criteria Manual, Volumes 1, 2, & 3”. Denver, Colorado, Volume 1, August 2018; Volume 2, January 2017; Volume 3, October 2019.

WRC Engineering and Urban Drainage & Flood Control District, “Storm Drainage Design and Technical Criteria”. Arapahoe County, Colorado, 1987.

## **1.9 DRAINAGE PUBLICATIONS FOR ENGLEWOOD**

The following publications are documents that pertain to the City of Englewood’s drainage systems known at the time of publishing.

### **FHAD Studies:**

- ❑ Big Dry Creek (Arapahoe County) and Tributaries, WRC Engineering, 11-1996
- ❑ Big Dry Creek, Downstream of County Line Road, RESPEC, Inc., 02-2018
- ❑ Harvard Gulch and Dry Gulch, Matrix Design Group Inc., 02-2017
- Harvard Gulch, West Harvard Gulch and Dry Gulch, Gingery Associates, 12-1979

### **Master Plans:**

- ❑ Big Dry Creek (Arapahoe County) and Tributaries Master Drainage Planning, Phase B, Preliminary Design Report, WRC Engineering, 4-1998
- ❑ Big Dry Creek (Arapahoe County) and Tributaries Master Drainage Planning, Phase A, Evaluation of Alternatives Report, WRC Engineering, 7-1996
- ❑ Big Dry Creek, Volume I, Major Drainageway Master Plan Report, VTN, Inc., 6-1975
- ❑ Big Dry Creek Major Drainageway Master Plan, VTN, Inc., 12-1974
- ❑ Big Dry Creek Major Drainageway Master Plan, Ayers Associates, 6-2015 Harvard Gulch and Dry Gulch Major Drainageway Plan, Matrix Design Group Inc., 12-2016.
- ❑ Little Dry Creek, Volume I – Major Drainageway Planning Report, McCall-Ellingson and Morrill, Inc., 2-1974
- ❑ Little Dry Creek Major Drainageway Planning, Volume 2 Drawing Report, McCall-Ellingson and Morrill, Inc., 2-1974
- ❑ South Platte River – Chatfield Dam to Baseline Road, Phase B, Volume I Major Drainageway Planning Report, Wright Water Engineers, Inc., 11-1985
- ❑ South Platte River – Chatfield Dam to Baseline Road, Phase B Volume II Recreation Plan, Major Drainageway Planning Report, Wright Water Engineers, Inc., 11-1985

#### **Outfall Studies:**

- ❑ Englewood Outfall Systems Planning, Preliminary Design Report, Turner Collie and Braden, Inc., 9-99
- ❑ Englewood Outfall Systems Planning Alternative Evaluation Report, Turner Collie and Braden, Inc., 2-98
- ❑ Englewood Outfall Systems Plan update, Draft, Calibre Engineering Inc., XX-2019

#### **Special Reports:**

- ❑ City of Englewood Probable Areas Affected by Flooding from the 100-Year Storm, Turner Collie and Braden, Inc., 3/98
- ❑ Little Dry Creek, City of Englewood, Cherry Hills Village, Greenwood Village, Arapahoe County Hydrologic Evaluation, McLaughlin Water Engineers, 7-86
- ❑ South Platte River – A Plan For The Future – Chatfield to Brighton, a Friend, A Foe, MHFD, 12-85
- ❑ South Platte River – Chatfield Reservoir to Brighton – Planning for the Future Brochure, 11-83
- ❑ South Platte River – Chatfield Dam to Baseline Road Stream Stability Investigation Final Report, Michael A. Stevens, Consultant, 12-83
- ❑ South Platte River Hydrologic Study – Chatfield to Sand Creek, Merrick and Company, 5-83
- ❑ City of Englewood Storm Drainage Plan, Sellards & Grigg, Inc. 1-71
- ❑ Floodproofing Study and Outfall System Plan update, DRAFT, Calibre Engineering Inc., XX-2019

## **SECTION 2.0**

### **STORM DRAINAGE PLANNING & SUBMITTAL REQUIREMENTS**

#### **2.1 GENERAL**

The Public Works Department has established and the City Council has adopted construction standards and engineering regulations for Development. All subdivision plats, planned unit developments, or any other proposed construction submitted for approval shall include an adequate drainage system analysis, BMP analysis, stormwater management analysis and appropriate storm drainage system design. Plans, engineering analysis and calculations, diagrams, drainage reports and other data shall be submitted, as required by the Public Works Director, with each development proposal or application for permit. The Developer is encouraged to have his Engineer meet with the Public Works Department so that the technical aspects of the project can be discussed prior to submitting plans and reports.

The Public Works Department in conjunction with City staff in other departments review these submittals to insure conformance with City Standards. The City of Englewood is not responsible for the correctness of design, dimensions, details, or quantities. All submittals are to be prepared by a registered professional engineer licensed in the State of Colorado.

#### **2.2 REVIEW PROCESS**

Adequate time must be allocated in development planning to permit a complete review. The intent of this Manual is to more clearly define the City's criteria and reduce the time and effort required to develop an acceptable drainage study. To improve the review process, all reports will receive an initial review using the checklist in Appendix B to determine if all essential information is present. Engineering review of the drainage plan will not be started until all essential information is present. Design Engineers are encouraged to refer to the Drainage Report Submittal Outline (Appendix C) and to substantiate that all the needed information has been provided or explain why items were not provided.

#### **2.3 SUBMITTALS**

Two copies of plans and two copies of reports are required for each initial submittal. If additional copies are required for agency referrals, the applicant will be notified.

Drainage reports are required and must be submitted in accordance with the requirements stated in this Manual. Any comments made by the Public Works Department must be addressed and the documents resubmitted until an approval is given.

Checklists<sup>2</sup> have been developed in order to identify the information that needs to be provided in drainage report submittals. The checklists may be used to determine the adequacy of the submittal. Incomplete or key information omitted from the report may result in the report being rejected for review, which could result in a significant delay in the development process.

An important part of the design and analysis of any hydraulic facility is the documentation. Drainage reports are required and must be submitted in accordance with the requirements stated in this Manual. Drainage Reports and Plans shall include, as a minimum, the information in Appendix C – Drainage Report Submittal Outline. The required submittal items for the different types of development are shown in Table 1.

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<sup>2</sup> Appendix B – Initial Review Checklist, Appendix C – Drainage Report Submittal Outline, Appendix E contains the checklist for drainage construction plans, and Appendix G contains the Best Management Practices Plan Requirements.



**Table 1 – Document Submittal Requirements**

| <b>Development Size</b>   | <b>Preliminary Report Requirements</b> | <b>Final Report Requirements</b> | <b>Stormwater Management Plan<sup>3</sup> Requirements (Construction)</b> | <b>Permanent Stormwater Quality<sup>4</sup> Plan (Post-Construction)</b> |
|---------------------------|--|----------------------------------|---|--|
| <b>5,000 sf to 0.5 Ac</b> | Letter Report <sup>6</sup>             | Final Report <sup>7</sup>        | SWMP Required   | BMP Required   |
| <b>0.5 AC or Greater</b>  | Preliminary Report <sup>9</sup>        | Final Report                     | SWMP Required   | BMP Required   |

## **2.4 SUBMITTAL REQUIREMENTS**

### **1) Format**

Drainage reports shall be prepared on standard size paper (8½ x 11). The full reports shall be suitably bound including cover, tabs, etc., but a letter report may be stapled if less than ten (10) pages. Every copy of the report shall include a “Drainage Plan Sheet”, which may be either folded and bound with the report, or folded and placed in a pocket, which has been bound within the report.

### **2) Drainage Plan Sheets**

The “Drainage Plan Sheets” shall consist of a 24-inch x 36-inch paper copies that are included with the reports. Any revisions to the drainage plan sheets shall be noted on the plans together with revision dates. Once deemed acceptable, two copies of the drainage plan(s), signed and sealed by the PE, shall be submitted

The approved Drainage Plan Sheet shall be a part of the construction documents, plans and specifications for the proposed development. No building permit will be issued unless the approved Drainage Plan Sheet is included among the construction documents.

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<sup>3</sup> For the purposes of this Manual SWMPs are the Construction BMPs that deal with erosion control, sediment control, and drainageway protection.

<sup>4</sup> Stormwater Quality Management Practices – physical, structural, nonstructural, and/or managerial practices that are intended to prevent, mitigate, or reduce pollution of stormwater and improve water quality.

<sup>6</sup> If Letter Report indicates that all flows are going to be directed to a Public ROW and no flows are exiting the site onto adjoining private properties and there are no floodplain or drainage problems associated with the site, then no additional reports will be required unless a more detailed analysis is requested by the Director of Public Works.

<sup>7</sup> Only required in cases where runoff must be directed onto adjoining private properties or floodplain or drainage problems are associated with the developing the site or a more detailed analysis is requested by the Director of Public Works

<sup>9</sup> Required if parcel in question must go through the preliminary platting process, otherwise at the PE’s discretion either a preliminary report can be submitted or PE may elect to proceed to final.

3) Stormwater Management Plans (Construction BMPs)

The Stormwater Management Plan must be included with the final report, but is not required for a preliminary report. USDCM (Volume 3 – Construction BMPs) shall be followed for developing construction BMP measures for the project site and the associated map symbols shall be used on SWMP submittals. SWMPs shall be 24-inch x 36-inch paper copies included with the report.

Within reason, the SWMP may be included on the Drainage Plan Sheets. The details of both erosion control methods and drainage design must be legible and clear. If they are not clear when drawn together, or if the Public Works Department requests it, the plans shall be drawn separately.

No building permit will be issued unless the approved SWMP is included among the construction documents and is signed and sealed by a professional engineer.

4) Permanent Stormwater Quality Management Plan (Post-Construction BMPs)

All submittals shall include a section that describes the Post-Construction BMPs that prevent or minimize water quality impacts. See Section 2.11

5) MHFD Design Spreadsheets

The MHFD maintains a library of Hydrologic and Hydraulic Software, Design Tools and BMP Sizing tools that may be used as a part of the submittal. All calculations submitted shall be complete and presented in a logical format that is easily read. Time of Concentration calculations and Rational Method runoff calculations shall use forms SF-2 and SF-3 (or a reasonable facsimile).

## **2.5 LETTER REPORT**

1) General Provisions

A letter report replaces a preliminary report for development sites less than 0.5 acre; although, the Public Works Director has the right to require a drainage report, or any part of, if it is deemed necessary. The letter report shall include a letter written to the Public Works Department briefly summarizing the proposed development and include a completed “Small Lot Development Form”, found in the Appendix D of this Manual, and a site plan with the necessary information provided. The letter report will be submitted to the Public Works Department for review and comment or approval.

A letter report may also be submitted for a development or redevelopment that will not increase the historic runoff from the site, or in certain cases where the increased runoff will not exceed the allowable limits from the master plan studies as listed in Section 1.9, or when the increase in runoff is minor and it is obvious that the developed flows will not cause any hardship to downstream property owners, or overburden existing municipal systems. The letter report shall provide all necessary documentation in order to substantiate that the requirements for a letter report are met. The Public Works Department may approve the letter report if all the issues have been satisfactorily addressed. Letter report approvals are strictly at the discretion of the Public Works Director. If the Public Works Director determines that the flows from a development do not meet the criteria established for a letter report, then the applicant must provide a final drainage report that meets the criteria of the City.

2) Procedure

Two (2) copies of the letter report will be submitted for preliminary review. The Public Works Department will review and make any comments deemed necessary on the submitted drainage report and may return an annotated review copy to the submitter in cases where it would help to clarify the City’s comments or concerns.

If corrections are needed, the Public Works Department shall request the letter report be resubmitted with corrections. A resubmittal, if requested by the Public Works Department, must be accompanied with the annotated review copy containing the City’s comments. All resubmittals shall include a cover letter summarizing how the City comments were addressed. Letter reports

and the plan sheets shall be signed and sealed by the professional engineer that provided guidance, supervision, and is responsible for the design.

After the report is approved, then the construction plans submitted for building permit approval must contain sufficient information to document the assumptions and recommendations contained in the letter report.

## **2.6 PRELIMINARY REPORT**

- 1) Purpose  
The purpose of the preliminary report is to identify and define drainage problems associated with the proposed development, and to define conceptual solutions. For a detailed list of the submittal requirements, see Appendix C – Drainage Report Submittal Outline.
- 2) Rezoning Proposals  
When a rezoning application and approval is conditional upon site plan approval, a preliminary report is required.
- 3) Procedure  
Two (2) copies of the preliminary drainage report will be submitted for review. The Public Works Department will review and make any comments deemed necessary on the submitted drainage report and may return an annotated review copy to the submitter in cases where it would help to clarify the City's comments or concerns.

If major corrections are needed the Public Works Department may request the preliminary report be resubmitted with corrections. A resubmittal, if requested by the City, must be accompanied with the annotated review copy containing the City's comments. All resubmittals shall include a cover letter summarizing how the City comments were addressed.

In most cases the Public Works Department will request that the City's review comments or concerns be addressed with the final drainage report. This can be accomplished by the City attaching a conditional approval letter to the preliminary report that will list the items that need to be addressed in the final drainage report. Approved preliminary reports and the plan sheets shall be signed and sealed by the PE that provided guidance, supervision, and is responsible for the design.

## **2.7 FINAL DRAINAGE REPORT**

- 1) Purpose  
The purpose of the final report is to transform the preliminary plans or conceptual plans to construction plans. Final drainage reports are normally prepared and submitted with any documents that will result in easements and rights-of-way to be recorded, or permanent structures being built, such as the final plat, planned development, site plan, or building permit. The final drainage report shall contain all calculations and information identified in Appendix C—Drainage Report Submittal Outline.
- 2) Procedure  
Three (3) copies of the final report will be submitted for Public Works Department approval. The Public Works Department will review and make any comments deemed necessary on the submitted drainage report and may return an annotated review copy to the submitter in cases where it might help to clarify the City's comments or concerns. All City review comments must be addressed. All resubmittals shall include a cover letter summarizing how the City comments were addressed, and in cases where annotated plans were provided, the annotated review copy containing the City review comments should be included with the resubmittal. The final report will be resubmitted until all comments and correction requests are satisfactorily addressed.

When the Public Works Department deems the final drainage report acceptable, three (3) copies of the drainage report and the “Drainage Plan Sheet” must be submitted for approval. The reports and the plan sheets shall be signed and sealed by the professional engineer that provided guidance, supervision, and is responsible for the design.

After the report is approved, then the construction plans are submitted for building permit approval and must contain sufficient information to document the assumptions and recommendations contained in the final drainage report and plan. The building permit submittal package must include the SWMP and the approved drainage report and plans.

## **2.8 FLOOD HAZARD STUDY**

### **1) General Provisions**

Proposed development or improvements in the flood hazard zone shall meet the requirements of Title 16 of the Englewood Municipal Code – Unified Development Code. EMC Title 16-4: Floodplain Overlay District can be found in Appendix H. The flood hazard study shall be in the form of a final drainage report and shall include all such computations necessary to show that the requirements of Title 16 are met.

Copies of the City of Englewood Flood Hazard Boundary Map or the Arapahoe County FIRM maps may be obtained through the City Floodplain Administrator.

### **2) Floodplain Zoning Permit**

A Floodplain Zoning Permit and a Development Permit must be obtained from the Floodplain Administrator before any major drainageway can be altered or relocated. Whenever a Development proposes to alter a major drainageway, the Developer is responsible for submitting construction plans and calculations that meet MHFD criteria, and then to build the necessary improvements in accordance with MHFD requirements so that the improvements will be eligible for MHFD maintenance. In addition, the CLOMR, and LOMR, and all other costs related to revising Floodplain or Floodway locations and limits, shall be borne by the Developer and shall be done in accordance with FEMA criteria. A CLOMR must be issued by FEMA prior to the City issuing a building permit for any structure where Floodplain modifications are necessary, and when construction is completed the Developer is required to prepare and submit all required documents for FEMA approval and issuance of a LOMR.

### **3) Floodplain Development Permits**

A Development Permit must be obtained from the Floodplain Administrator prior to the use of any fill, construction of structures, or storage of materials in any portion of a floodplain.

### **4) Floodways**

Because Floodways are extremely hazardous due to the velocity of floodwaters, which carry debris, and because the drainage conveyance capacity of the drainageway must be protected and maintained, all encroachments, fill, new construction, substantial improvements and all other development are prohibited in any area designated as a Floodway except for:

- a) New improvements that are intended to increase the capacity or the storage capability of the Floodway.
- b) New improvements that are intended to increase flood protection, decrease erosion, and improve channel hydraulics, or to provide stormwater quality benefits.
- c) Utilities that are designed, located, and installed such that:
  - (i) They are anchored and armored to withstand hydrostatic and hydrodynamic forces, and the effects of buoyancy.
  - (ii) Equipment and appurtenances installed are resistant to flood damage.
  - (iii) The utilities will not permit infiltration of floodwaters into the system and/or will not discharge from the system into the Floodway.

5) Disclaimer

The degree of flood protection required by Title 16 is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods than the 100-year design storm can occur. Conformance to the requirements in Title 16, or this Manual, does not imply that areas will be free from flooding or flood damage.

## **2.9 WETLANDS**

Wetlands provide multiple important functions in an urban drainage system. A wetland can reduce the peak flow discharge, provide park and aesthetic benefits, as well as improve the water quality of storm runoff.

Existing Wetlands are protected by federal regulations. Disturbing or cutting wetland vegetation with designated wetland areas is prohibited except for the following:

- Hand cutting or removal by hand of noxious weeds;
- Thinning wetland vegetation to minimize mosquito habitat in accordance with a plan prepared by an environmental specialist, and approved by the City.
- Work performed to protect the public health, safety, and welfare.

The applicant shall identify existing wetland areas that potentially could be impacted by the proposed Development. Care should be taken not to encroach into a wetland, and to avoid causing changes that will affect the water sources to a wetland.

To the extent possible, no utility lines shall be located in wetlands. Prior to any disturbance to a wetland, the U.S. Army Corps of Engineers shall be contacted to determine if there are any 404 Permit requirements.

## **2.10 STORMWATER MANAGEMENT PLAN (CONSTRUCTION)**

1) General

The Federal Clean Water Act requires that stormwater discharges be authorized under stormwater discharge permits. A General Permit issued by the Colorado Department of Health and Environment, Water Quality Control Division covers stormwater discharges from the City of Englewood. Construction site stormwater runoff control is one of the minimum measures that Englewood must address in order to be in conformance with the Colorado Discharge Permit System, or CDPS, under Regulation 61. Disturbed lands are subject to Erosion and can be a source of significant discharges of sediment and other pollutants to receiving waters downstream.

Disturbed lands include all property from which vegetation has been or is to be temporarily or permanently removed. A SWMP for the site is required if the disturbed area is greater than 10,000 square feet, or if the soil area is to be exposed for more than sixty (60) days (Englewood Municipal Code 16-6-8). A SWMP for the site must be developed and submitted to the Department of Public Works to obtain a building, construction, or site-grading, paving, or development permit. This plan will identify the site specific control measures necessary to prevent and control soil erosion, sedimentation, and water pollution that may degrade receiving waters downstream.

2) Contractor Responsibility

The contractor shall provide control measures to prevent or minimize the impact to receiving waters as required by the plans and/or as directed by the Engineer in writing. The Contractor shall effectively prevent and control erosion and sedimentation on construction sites at the earliest practicable time. In general control measures will be implemented prior to the commencement of each construction operation or immediately after the area has been disturbed.

Construction staging areas and vehicle maintenance activities shall be managed and controlled so as to minimize the runoff of pollutants.

Disturbance of vegetation shall be minimized and limited to only what is shown on the construction plans or as directed by the Design Engineer in writing.

All erosion, sediment and water pollution controls will be maintained in good working order. On all projects where the disturbed area is equal to or greater than an acre, a rain gauge shall be provided by the Contractor and located on the project site. Within 24 hours of a rainfall event of 0.2 inches or more as measured at the project rain gauge, the Contractor will inspect the entire project to determine the condition of the control measures. Sediment will be removed and devices repaired as soon as practicable but not later than 7 days after the surrounding ground has dried sufficiently to prevent further damage from equipment needed for repair of control measures.

3) Owner Responsibility

All construction stormwater best management practices (BMPs) developed are the documents that permit approvals are conditioned upon. The Owners and Developers of the real property are ultimately responsible for the proper installation and maintenance of all construction stormwater BMPs. If the Contractor/Developer fails in this responsibility the City shall provide a verbal warning to the Responsible Party, if the situation is not remedied, then a notice of violation shall be issued as well as a stop work order for any work at the site, except for work necessary for bringing the site into compliance with the SWMP. Failure to respond to the notice of violation will result in a municipal summons. If necessary, the City has the right to enter the property, perform maintenance on the BMPs, and require reimbursement for the costs that may be incurred.

The control measures identified on the plan shall be installed and maintained throughout construction and these efforts shall be coordinated with the permanent pollution control features specified for the project's post construction period. The Owner's Representative shall inspect the construction BMP control measures after each storm event in excess of 0.2 inches. All deficiencies shall be noted and any necessary changes or maintenance will be completed within 24 hours. Modifications to the SWMP shall be submitted to the Public Works Department within seven days.

4) Owner Acknowledgement

All SWMPs and BMPs shall include an “Owner Acknowledgement” block for the Property Owner’s signature. The format for the Owner Acknowledgement shall be:

All stormwater best management practices (BMPs) developed and included in the development approval process are legally binding documents whereby the Owners of the real property associated with the BMPs are held ultimately responsible for the proper maintenance of all stormwater BMPs. If the Property Owner fails in this responsibility, the City has the right

1. To enter the property, perform maintenance on the BMPs, and require reimbursement for the costs that may be incurred, or
2. To declare the existence of a nuisance and issue Nuisance Abatement Notice to the responsible party. Failure to comply with the Nuisance Abatement Notice shall cause the person, corporation, partnership, or other entity violating the stormwater management provisions of the Manual to be subject to Title 15 of the Englewood Municipal Code.

I have reviewed the stormwater best management practices that are proposed and I understand that the effective performance of BMP measures hinge upon proper maintenance of the BMPs used, and I will commit to provide the required maintenance and employee training program, in order to accomplish the goal of preventing or reducing pollutant runoff from this property.

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Owner

Date

5) Project Management Principles

Careful project management and adherence to the following principles can achieve erosion and sediment control:

- ☐ Fit the Development to the existing topography, soils, and vegetation as much as possible.
- ☐ Schedule construction operations in order to minimize soil exposure.
- ☐ Minimize disturbance and soil exposure by retaining natural vegetation, adopting phased construction techniques, and using temporary cover.
- ☐ Vegetate and mulch all denuded areas to protect the soil from precipitation in order to minimize the raindrop impact on bare soil.
- ☐ Minimize the steepness of slopes and control lengths of slopes by utilizing benches, terraces, contour furrows, or diversion ditches.
- ☐ Utilize riprap, channel linings, or temporary structures in channels to slow runoff velocities and allow drainageways to handle increased runoff from developed areas.
- ☐ Keep sediment on-site by utilizing sediment basins, traps, or sediment barriers.
- ☐ Monitor and inspect sites frequently to assure the measures are functioning properly and correct problems promptly.

The Construction BMP chapter in USDCM (Volume 3) shall be followed for implementing erosion control measures on the project site. The objectives and requirements for the Stormwater Management Plan are identified in Appendix G – Stormwater Quality Best Management Practices Plan Submittal Requirements.



## 2.11 PERMANENT STORMWATER QUALITY PLAN (POST-CONSTRUCTION)

### Introduction

Englewood's National Pollution Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) General Permit issued by the Colorado Department of Health and Environment mandates that adequate pollution control measures for both the construction and post construction periods are provided and maintained. All commercial and industrial developments, regardless of size and type, must provide an evaluation of the possible pollution sources that are common for the proposed uses and identify the Structural and Nonstructural controls that are going to be provided to mitigate adverse impacts to State Waters. The requirements for the Stormwater Quality Management Plan are outlined in Appendix G. BMP Owners are responsible for performing the required maintenance to ensure the long-term operation and viability of stormwater quality facilities (structural and nonstructural).

### Water Quality

Water quality is an important part of site planning and design. A four-step process for stormwater quality management is described in the Stormwater Management and Planning chapter in the USDCM (Volume 3) and should be employed on all sites during the planning and design process. The four steps are listed below.

- ❑ Step 1. Employ Runoff Reduction Practices
- ❑ Step 2. Implement BMPs that provide a Water Quality Capture Volume (WQCV) with slow release
- ❑ Step 3. Stabilize drainageways
- ❑ Step 4. Implement site specific and other Source Control BMPs

With the NPDES regulations, it is essential that the City, the Design Engineer, the Property Owner, and Contractors work together to design and implement Best Management Practices (BMPs) to clean and/or prevent the pollution of stormwater. Pollutants come from stormwater runoff (rain) or non-stormwater runoff (such as sprinklers, hoses, or cleaning devices). Refer to the BMP Selection chapter in the USDCM (Volume 3) for guidance in selecting the appropriate structural BMPs for a project site. Water quality treatment can occur with a standalone facility, in combination with detention facilities or as part of a targeted source of pollution or planning effort.

#### 1) Water Quality Control Measures

When developing a site, water quality control measures, or BMPs, are designed to improve water quality and reduce hydromodification and the associated impact on receiving waters as described in the USDCM (Volume 3). Englewood has adopted the approach for calculating the WQCV found in the USDCM (Volume 3).

Water quality facilities in Englewood shall be designed to capture and treat runoff from the 80<sup>th</sup> percentile event which is equal to a rainfall depth of 0.6 inches. Calculation of the WQCV is dependent on proposed site imperviousness and the type of BMP selected. See the Calculating the WQCV and Volume Reduction chapter in the USDCM (Volume 3) for equations and guidance in calculating the WQCV. The Treatment BMPs chapter in the USDCM (Volume 3) provides a listing of treatment BMPs and design criteria for post construction urban runoff control measures. Alternate designs may be considered, but they must meet the functional requirements of the BMPs identified by MHFD.

#### 2) WQCV and Full Spectrum Detention

WQCV functions are incorporated into Full Spectrum Detention- Guidance for incorporating five types of WQCV treatment BMPs into detention facilities is provided in the USDCM Volume 2 (Storage Chapter).

### 3) Industrial and Commercial BMPs

Special consideration should be given to industrial and commercial impacts to a site. If developing an industrial site the Source Control chapter USDCM (Volume 3 – Source Control BMPs) should be followed.

## Designing for Maintenance

During design, consideration must be given to the short and long-term maintenance of all BMPs. Long term success dictates that each BMP must perform its intended function. All stormwater quality management plans developed and included in the development approval process are legally binding documents whereby the Owners of the real property associated with the BMPs are held ultimately responsible for the proper maintenance of all stormwater BMPs, if the Property Owner fails in this responsibility the City has the right to enter the property, perform maintenance on the BMPs, and require reimbursement for the costs that may be incurred.

Because the effective performance of BMP measures hinge upon proper maintenance of the BMPs used, signed acknowledgements by the Property Owner must be given to the Public Works Department that identify the Structural and Nonstructural controls, the required maintenance and employee training program, and their commitment to the goal of preventing or reducing pollutant runoff from their property.

All Permanent Stormwater Quality Plans shall include the Owner's Acknowledgement Statement in section 2.10

## 2.12 INSPECTION AND RECORD DRAWINGS

A professional engineer retained by the Developer, preferably the Design Engineer, shall inspect the construction of the improvements for the purpose of determining conformance with the approved drainage plan. This inspection shall include verification that the following conform reasonably to the drainage plan:

- ❑ Finished floor elevations
- ❑ Sizes, grades, locations, and elevations of drainage structures, channels, pipes, etc.
- ❑ Drainage facilities are located within the dedicated drainage easements.
- ❑ Location of basin boundaries
- ❑ Detention pond volumes
- ❑ Facilities appear to be constructed in a workmanlike manner
- ❑ Facilities and onsite grading function as intended in accordance with the approved drainage report and plans.
- ❑ Stormwater Management control measures implemented or constructed.
- ❑ Best Management Plan measures implemented or constructed.
- ❑ Wetland mitigation measures implemented
- ❑ Floodplain boundaries certified
- ❑ Permanent field benchmark verified and certified

Any significant deviations from the approved drainage plan shall be annotated on the Record Drawings. Redline or cloud mark-ups of the approved construction drawings are the preferred method for indicating significant deviations. Significant deviations are those that exceed the following tolerances:

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>❑ Elevations.....± 0.2 ft.</li> <li>❑ Slopes .....± 10.0%</li> <li>❑ Distances.....± 1.0%</li> <li>❑ Volumes .....± 5.0%</li> </ul> | deviation from specified slope or grade,<br>(i.e. 0.2% deviation for a 2% design grade) |
|--|---|

The Engineer will note any significant deviations on the approved drainage plan sheet and place the certification and notations required for the “as-built” drainage plan. When the Design Engineer is satisfied with the work that was done, then the Engineer shall include the following statement on the Record Drawings:

I hereby declare that: I have performed a field review of the constructed drainage facilities on this plan. The facilities are in substantial conformance to the approved drainage plan, they appear to have been constructed in a workmanlike manner, and the as-built improvements will function and perform in accordance with the intended purposes of the approved drawings and specifications.

*(Seal and Date)*

\_\_\_\_\_  
Registered P.E., State of Colorado  
No. \_\_\_\_\_

The document will then be returned to the Public Works Department for filing as the Drainage Plan Record Drawing. The Record Drawings must be on file before a Certificate of Occupancy will be issued.

## **SECTION 3.0 DRAINAGE POLICY**

### **3.1 GENERAL**

Providing for adequate drainage in Englewood is necessary in order to preserve and promote the general health, welfare and economic wellbeing of the city and the surrounding area. Drainage is a regional issue that affects all governmental jurisdictions. As a result any successful drainage system will require an integrated approach to drainage that involves public and private concerns working together.

### **3.2 JURISDICTION BOUNDARIES**

Since drainage considerations and problems do not respect jurisdictional boundaries, the policy of the City shall be to cooperate fully with neighboring jurisdictions and make every effort to address their issues and concerns. Drainage referrals will be sent out to MHFD and neighboring jurisdictions when a Development is located in proximity to a major drainageway or a city boundary.

### **3.3 BASIN TRANSFERS**

The diversion of storm runoff from one basin to another shall be avoided unless specific and prudent reasons justify and dictate such a transfer. In general inter-basin transfer must be prevented since it violates a basic principal of drainage law that upstream properties have a natural easement to discharge onto downstream properties so long as it is not sent down in a manner or quantity that causes more harm than formerly.

### **3.4 DRAINAGE IMPROVEMENT COSTS**

Where drainage improvements are identified by site-specific drainage reports or by drainage master plans as needed in order to facilitate development or redevelopment then the costs to design and build the required drainage improvements shall be borne by the Developer. In other words, because the development is creating the need for the drainage improvements in order to facilitate development, then the costs for the improvements should be borne by the Development and not the citizens of the City of Englewood. Examples where developments should bear all the costs of drainage improvements are:

- ❑ All curbs, gutters, channels, detention areas, inlets, storm sewers, culverts, bridges, swales and other drainage facilities that are required to facilitate development of the site.
- ❑ All minor channel improvements required that must be built in order to maximize the use of the site.
- ❑ All major channel improvements in cases where the Developer chooses to maximize the use of the site and/or encroach into an official Floodplain as identified in Title 16 of the EMC. The Developer is creating the need for these improvements since filling in the Floodplain reduces valuable channel storage capacity and therefore increases downstream flow peaks.
- ❑ All extensions of the existing storm drainage system through or around the Development where pipe size is 24-inch diameter or smaller.
- ❑ Any changes or modifications to the existing storm drainage system that must be done to facilitate development.

The exceptions to this general policy are when the City requires that the new Development or redevelopment to install larger or additional drainage improvements than what is necessary to facilitate development. Examples where City participation should be provided are:

- ❑ Where detention areas are increased in order to require the Development to provide regional detention for offsite areas.

- ❑ Where pipe sizes are greater than 24-inch diameter in order to accommodate offsite drainage.
- ❑ Where pipe or channel sizes are increased to handle future developed flows from upstream areas, then the differential costs for increasing the pipe or channel size should be subject to City participation.
- ❑ In cases where City exactions of drainage improvements are not proportional to the impacts caused by the Development.

### 3.6 DETENTION (STORAGE) AND STORMWATER QUALITY

Development along with the increase in impervious area increases peak flows and stormwater runoff from a site and can alter the duration of storm runoff. Temporarily detaining stormwater runoff can significantly reduce downstream flood hazards as well as reduce pipe and channel improvement requirements and provide water quality treatment. Full spectrum detention facilities are required as described in the USDCM because they provide stormwater peak flow control for a range of flow events and reduce flooding, stream degradation and water quality impacts related increased peak, duration and frequency the additional stormwater runoff originating from increased impervious surface. However, the benefits can only occur with consistent administration of detention requirements and proper maintenance of the facilities.

All New Developments and Redevelopments and meet the following detention and stormwater quality requirements;

| Development/Redevelopment Characteristics   | Detention Criteria  |
|---|---|
| Sites 0.5 acres or greater with disturbance of 10,000 sf or greater<br>All Planned Unit Developments        | Permanent Stormwater Quality (Post Construction)<br>Full Spectrum Detention   |
| Sites 0.5 acres or greater, but less than 1.0 acre with disturbance less than 10,000 sf                     | Permanent Stormwater Quality (Post Construction) for disturbed area<br>Provide stormwater detention to reduce the peak flow to pre-developed rates. |
| Sites from 5,000 safe to 0.5 acre where the weighted imperviousness is increased by a factor of 1.5 or more | Permanent Stormwater Quality (Post Construction) for disturbed area<br>Provide stormwater detention to reduce the peak flow to pre-developed rates. |
| Building or parking/drive expansion of 500 s.f. or less   | Exempt  |
| Detached Single Family Residence on a minimum lot size of 6,000 s.f.  | Exempt  |

The maximum allowable 100-year release rate for a full spectrum detention facility for new development is equal to 90 percent of the predevelopment discharge for the upstream watershed as described in the Storage chapter of the USDCM (Volume 2).

### **3.7 ROOFTOP DETENTION**

Rooftop detention is prohibited. Rooftop detention does not provide the water quality benefits; ponding water on roofs lead to premature failure of roofing systems; and the City cannot readily monitor changes and alterations to roof detention facilities.

### **3.8 IRRIGATION FACILITIES**

Irrigation ditches are designed with flat slopes and limited carrying capacity, which decreases in the downstream direction. As urbanization occurs, ditch rights are sold and irrigation ditches are abandoned. Developed stormwater runoff flows must be directed away from irrigation ditches. If the developed flows cannot be directed away from the ditch, then the ditch will either need to be piped or diversion structures installed downstream to remove excess storm flows from the ditch once the design capacity of the ditch is exceeded.

### **3.9 OFFSITE FLOWS**

One of the precepts of drainage law is that upstream properties own a natural easement on downstream properties for surface waters flowing in its natural course. Therefore it is incumbent on downstream properties to analyze offsite areas that may contribute flows onto their property and mitigate the impacts of those flows. The offsite storm runoff shall be determined and included in the drainage system design. Available drainage reports for developed offsite areas affecting the property shall be reviewed and considered in the drainage system planning and design.

Runoff entering the site from offsite areas shall be computed using runoff coefficients found in the Runoff chapter of USDCM (Volume 1).

### **3.9 EASEMENTS AND RIGHTS-OF-WAY**

In the event that any watercourse, channel, stream, creek, or other natural drainage channel traverses part or all of a proposed development, the subdivider shall dedicate adequate easements for storm drainage and maintenance access purposes.

#### **1) Public Drainage Easements**

There are Public Drainage Easements that are provided to convey public drainage that are deeded for the purposes of operation, repair, alteration, and maintenance of the storm water management system where the City has accepted maintenance and operation responsibilities. These easements shall be adequate in order to provide access for construction and maintenance and shall also cover the outlet structure, storm water pipes, detention area berms, and other parts of the storm water management system that the City deems necessary to be granted to the City. Public Drainage Easements shall provide covenants running with the land stating that no buildings, fills, excavations, structures, fences, or other alterations shall be constructed within the easement without the express written consent of the Public Works Department.

#### **2) Drainage Conveyance Easements**

There are also Drainage Conveyance Easements that are provided for storm drainage flows from upstream lots onto downstream lots in order for the flows to be conveyed to the public drainage system. Drainage Conveyance Easements are also provided to cover permanent drainage improvements that are a condition of development such as the detention pond, outlet structure, storm water pipes, channels, pipes, inlets, detention area berms, and other parts of the storm water management system built to benefit the site, or upstream or downstream properties. The maintenance and operation of these drainage improvements are the responsibility of the Property Owner. Drainage Conveyance Easements shall provide covenants running with the land stating that no buildings, fills, excavations, structures, fences, or other alterations shall be constructed within the easement without the express written consent of the Public Works Department.

If for some reason the property owner fails to provide adequate maintenance or impedes storm drainage flows, the City may enter the property in order to maintain and or re-establish the drainage capacity, and perform any necessary work, the cost of which shall be the responsibility of the property owner.

### **3.10 OPERATIONS AND MAINTENANCE**

An important part of all storm drainage facilities is continued maintenance so that the system will continue to function as designed. Maintenance and access requirements shall be considered during the planning and design of all stormwater and detention facilities. Sediment and debris must be periodically removed from detention basins, channels and storm sewers. Trash racks, sidewalk chase drains, and inlets must be regularly cleared of debris to maintain system capacity. Channel bank erosion damage must be repaired to avoid progressive deterioration, reduced conveyance capacity, unsightliness, and structural failure. All sites will be designed to provide access for vehicles and the construction equipment necessary to provide continued minor and major maintenance.



## **SECTION 4.0**

### **TECHNICAL DESIGN CRITERIA**

#### **4.1 GENERAL**

The City of Englewood was incorporated in 1903. Englewood is a southern suburb of Denver and is surrounded by the cities of Denver, Littleton, Cherry Hills Village and Sheridan. The City of Englewood encompasses approximately 7 square miles. The City lies within the South Platte River watershed at the eastern foot of the Rocky Mountains and is exposed to the sudden, high intensity rainstorms typical of this region. A number of large drainage basins tributary to the South Platte River cut through the City (see *Figure 1 – Englewood Drainage Basin Map*). Because the City is mostly developed, there are existing storm drainage systems that are being used. There are also master plan studies that have been completed that evaluate the existing storm drainage systems and identify areas of need and recommended improvements. A list of the available master plans and studies can be found in Section 1.9—Drainage Publications for Englewood, of this Manual.

#### **4.2 RESPONSIBILITY**

The Design Engineer is responsible for the design produced. The calculations must follow the guidelines in the Manual, but the accuracy and applicability of the calculations are the responsibility of the Design Engineer.

#### **4.3 SOIL TYPES**

The predominant soil types in the City of Englewood fall into NCRS Hydrologic Soil Groups B and C. These primarily consist of sands, loams, and clays. Large portions of the city have loamy foothill material in the Nunn association in the “C” hydrologic soil group. The Floodplain areas for the South Platte River, Little Dry Creek and Big Dry Creek are alluvial lands also of the Nunn association. There are also large portions of the city that consist of well-drained soils of the Bresser association that are in the “B” hydrologic soil group. There are also pockets of gravelly areas along the Platte River. For “B” hydrologic soil groups, an initial infiltration rate of 4.5 inches per hour (iph) and the final infiltration rate of 0.6 iph can be used. For “C” hydrologic soil groups, the initial infiltration rate is 3.0 iph and the final rate is 0.5 iph. *Figure 3 – Englewood Soils Classification Map* identifies locations and soil classifications for the Englewood area. If the Design Engineer has site-specific soil test data available, then the site-specific data should be used.

#### **4.4 HYDROLOGY**

The MHFD has concluded that NOAA Atlas rainfall information provides reasonable rainfall information that should be used to develop design rainstorms. Rainfall depths for Englewood are listed in Table 5. The Intensity-Duration Curves found in *Figure 2* are derived from the Rainfall chapter of USDCM (Volume 1) The preliminary and final drainage reports shall take into consideration three separate storms events: water quality, the initial storm, and the major storm. Historic and developed runoff shall be determined for both storms for the site, including the entire basin tributary to the site.

##### **1) Storm Frequency**

The storm frequency to be used in drainage system design will be the storm frequency applicable for the facility being designed as described in a), b), and c) of this section.

- a. Water Quality: Refer to the Calculating the WQCV and Volume Reduction chapter of USDCM (Volume 3) for guidance in sizing WQCV facilities.
- b. Initial Storm: The initial storm occurs at frequent intervals. Drainage systems for the initial storm are to be designed to minimize inconvenience, protect against minor damage, and reduce maintenance costs.

The design frequency interval for the initial storm is the two (2) year storm for analyzing storm runoff in streets, private driveway culverts, and for self-cleaning velocity checks in storm sewer designs and culvert designs.

- c. Major Storm: The design frequency interval for the major storm is the 100-year storm. The drainage system for the major storm is to be designed to protect against loss of life, substantial property damage, and maintain critical or emergency services.

## 2) Rainfall Intensity

Runoff for both the initial and major storm shall be based on the Rainfall Intensity – Duration Curves for Englewood, Colorado shown in *Figure 2*.

**Table 5 – Englewood Rainfall Depths for 1 and 6-Hour Storms (NOAA Atlas 14, Volume 8, Version 2)**

| Storm Event | Rainfall Depth in Inches |              |
|-------------|--------------------------|--------------|
|             | 1-Hour Storm             | 6-Hour Storm |
| 2-Year      | 0.82                     | 1.27         |
| 5-Year      | 1.08                     | 1.65         |
| 10-Year     | 1.31                     | 1.99         |
| 25-Year     | 1.66                     | 2.51         |
| 50-Year     | 1.95                     | 2.94         |
| 100- Year   | 2.25                     | 3.41         |

According to MHFD analysis, the most intense rainstorms in the Denver area typically begin and end in the first hour of the storm. It is these short-duration, intense rainstorms that appear to cause the most flooding problems. Therefore, it is the short duration, convective type storm, which is used to provide the design storms used in this manual.

## 3) Runoff Computations

Five methods of hydrologic analysis are described in the Runoff chapter of USDCM (Volume 1) and listed below

- The Rational Method; based on the Rational Formula:  $Q=CIA$ . Refer to the Runoff chapter of USDCM (Volume 1) for the general procedure for Rational Method calculations, assumptions, limitations, time of concentration calculations, and runoff coefficient selection guidance.
- The Colorado Urban Hydrograph Procedure (CUHP) for generating hydrographs from watersheds, and
- The EPA’s Storm Water Management Model (SWMM), primarily for combining and routing the hydrographs generated from CUHP.
- Use of published runoff information, and
- Statistical analyses.

Watershed size dictates whether the Rational Method or CUHP is applicable. The Rational Method may be used for watersheds that are less than 90 acres. CUHP is applicable for watershed sizes from 0 to greater than 3,000 acres with basins above 160 acres requiring further subcatchment division. Please refer to the Runoff chapter of USDCM (Volume 1) for additional information on the applicability of hydrologic methods by watershed size.

CUHP and SWMM: CUHP is a method of hydrologic analysis based upon the unit hydrograph principle. Refer to the Runoff chapter of USDCM (Volume 1) for background and guidance in using CUHP. The Environmental Protection Agency’s (EPA’s) Stormwater Management Model

(SWMM) 5 is a computer model that is used to generate surface runoff hydrographs from subcatchments and then route and combine these hydrographs. The procedure described in the Runoff chapter of UDSCM (Volume 1) is limited to the routing of hydrographs generated using CUHP software in SWMM.

MHFD has published macro-enabled Microsoft Excel spreadsheets to assist with Rational Method (UD-Rational) and CUHP calculations. The spreadsheets are available at the MHFD website ([www.udfcd.org](http://www.udfcd.org)).

## **SECTION 5.0**

### **OPEN CHANNELS AND HYDRAULIC STRUCTURES**

#### **5.1 GENERAL**

The preliminary and final designs of open channels and hydraulic structures shall be as specified in this section and in accordance with USDCM (Volumes 1 and 2).

#### **5.2 OPEN CHANNELS**

The preservation, enhancement, and restoration of stream corridors in the City as well as the design of constructed channels and swales using natural concepts shall be in accordance with the Open Channels chapter of USDCM (Volume 1). The USDCM guidance on open channel design is based on the systematic application of key geomorphic and hydraulic principles and is encouraged to be undertaken by a qualified design team representing a broad range of expertise such as engineering, geomorphology, ecology, and landscape architecture.

Criteria referred to in this section appears in a number of chapters in USDCM (Volumes 1 and 2). Open channel design, the use of riprap and boulders, methods of hydraulic analyses, and design parameters for grass or rock-lined swales are all covered in the Open Channel chapter of USDCM (Volume 1). The hydraulic analysis and design of grade controls structures are covered in the Hydraulic Structures chapter of USDCM (Volume 2). Planning and design criteria for trails and access along channels are covered in the Stream Access and Recreational Channels chapter of USDCM (Volume 2). Revegetation along open channels is covered in the Revegetation chapter of USDCM (Volume 2).

Major channels include all streams, drainageways and channels that convey major storm discharges greater than 100 cfs, or any channel that has a designated floodplain on the City's Official Flood Hazard Map. Any major channel constructed must meet the "Maintenance Eligibility Guidelines" established by the MHFD.

#### **5.3 STREETS, INLETS, AND STORM DRAINS**

Design of streets, inlets, and storm drains for the purpose of conveying runoff shall be in accordance with the Streets, Inlets, and Storm Drains chapter of USDCM (Volume 1) except as specified in this section. In addition to design guidance in USDCM (Volume 1), MHFD has computer software design aids related to streets, inlets, and storm drains on their web site at <http://www.udfcd.org/>

##### **1) Streets**

The allowable gutter flow in streets shall not exceed the values given in *Figure 6 – Street Flows – Allowable Capacities*.

The allowable flows shown in Figure 6 were obtained using the Modified Manning's Formula, limiting the depth of flow for in the streets for storm runoff by the criteria in Table 11, and then applying the reduction factors shown in Figure 7; these factors limit flow velocities and account for reductions due to parked and moving vehicles that obstruct flows.

If the Design Engineer encounters street cross slopes that are not 2 percent, then allowable flow can be calculated using the methods in the USDCM (Volume 1).

**Table 11 – Allowable Street Inundation**

| <b>Initial Storm Runoff – 2- Year Storm</b>   |  |
|---|--|
| <b>Street Classification</b>  | <b>Maximum Encroachment</b>  |
| Local   | No curb overtopping. Flow may spread to crown of street.   |
| Collector   | No curb overtopping. Flow must leave at least one 10' wide lane free of water.   |
| Arterial  | No curb overtopping. Flow spread must leave at least one 10' wide lane free of water in each direction.  |
| <b>Major Storm Runoff – 100 Year Storm</b>  |  |
| <b>Street Classification</b>  | <b>Maximum Encroachment</b>  |
| Local and Collectors with Mountable Curbs   | The depth of water over the gutter flowline shall not exceed 7.5 inches.*  |
| Local and Collectors with Vertical Curbs  | The depth of water over the gutter flowline shall not exceed 9.5 inches.*  |
| Arterials   | Depth of water shall not exceed 6 inches at the street crown, in order to allow operation of emergency vehicles, and not exceed 9.5 inches at the gutter flowline, whichever is more restrictive.* |
| *Residential, public, commercial, and industrial development occurred prior to street improvements in most areas of Englewood. Streets were built to best-fit existing improvements. Therefore finish floor elevations are not necessarily elevated above the back of walk. |  |

## 2) Inlets

The standard inlets permitted for use in the City are:

**Table 12 – Standard Inlets Permitted**

| <b>Inlet Type</b>                     | <b>Standard Detail</b> | <b>Permitted Use</b>   |
|---------------------------------------|------------------------|--|
| Curb Opening Type R                   | <i>D-9</i>             | All Street Types   |
| Grated Type C Inlet                   | <i>D10</i>             | Medians and Detention Ponds where vehicle and pedestrian traffic is not permitted. |
| Grated Type 16 Inlet                  | <i>D-1</i>             | Alleys and Private Drives and Streets  |
| Grated Type 13 Inlet                  | <i>D-5</i>             | Landscaped Areas and Detention Ponds   |
| Combination Type 16 Open Throat Inlet | <i>D-2</i>             | All Street Types   |

## 3) Storm Drains

The hydraulic analysis of storm sewer systems shall be in accordance with the criteria presented in the USDCM, Volume 1 – Streets, Inlets, and Storm Sewers. Final grades, street geometries, types of construction, and all other street details relative to the design, construction, or operation of the storm sewer system must be approved by the Public Works Director.

The design of the storm sewer system shall include hydraulic analysis of both the minor and the major storm events. The hydraulic grade line (HGL) shall be calculated by accounting for pipe friction losses, expansion, contraction, bend, and junction losses. The methods for estimating these losses are provided in USDCM (Volume 1 – Storm Sewers). The HGL shall be plotted for all storm sewers. The HGL shall not be higher than 6-inches below the gutter flowline. When the hydraulic grade line cannot meet the 6-inch criteria then the capacity of the storm sewer will need to be improved by increasing pipe sizes.

Storm drain velocities shall be as shown in Table 15.

**Table 15 – Storm Drain Velocity Criteria**

|                  | <b>Initial Storm</b> | <b>Major Storm</b> |
|------------------|----------------------|--------------------|
| Minimum Velocity | 3.0 fps              | N/A                |
| Maximum Velocity | 16.0 fps             | 20.0 fps           |

- a) Construction Materials: Storm drains shall be constructed of reinforced concrete (Class III is the required minimum) meeting current CDOT Specifications. The systems shall be designed to handle anticipated loads. Other types of pipe material and sizes may be acceptable on private property, but the owner will be responsible for it. The Public Works Department may allow alternative pipe materials, if justified.
- b) Minimum Pipe Diameter: The minimum pipe diameter of storm drains shall be 15 inches.
- c) Horizontal Alignment: Storm drains shall usually be straight between manholes. Long radius curves are permitted for pipe diameters equal or larger than 24 inches. The radius of curvature shall be no less than the radius associated with the maximum permissible joint deflection specified by the manufacturer and no less than 100 feet.

Storm drains shall be no closer than 5 feet, measured horizontally from the outside of parallel sanitary sewer or water line to the outside of the storm drain. Storm drains shall be no closer than 18 inches vertically from any crossing utility lines.

Spacing of manholes shall conform to Table 16. Manholes shall conform to *Figure 14 – Standard Manhole Details*.

**Table 16– Manhole Spacing**

| <b>Pipe Size</b>       | <b>Maximum Spacing</b> |
|------------------------|------------------------|
| 15 inches to 36 inches | 400 feet               |
| 42 inches or greater   | 500 feet               |

The minimum width of easement for installation of a storm drain shall be the pipe diameter plus 15 feet with the pipe normally centered in the easement.

Vertical Alignment: Whenever possible, the crowns of the inlet and exit pipe should be aligned when the downstream pipe is larger than the upstream pipe within a manhole, in order to minimize backwater effects. The elevation drop through a manhole shall be no less than 0.2 feet. Refer to USDCM (Volume 1) for guidelines about shaping manhole bottoms and other details.

Storm drain grades shall be such that a minimum 18 inches cover over the crown of the RCP is maintained. If less cover is shown, the Engineer shall submit the pipe

structural design to the Public Works Director for approval. Uniform slopes shall be maintained between manholes. Final grades shall be set with full consideration to capacity required, sedimentation problems, and other design parameters. The minimum slope shall be capable of producing a velocity of 3 feet per second when the drain is conveying initial storm flows.

When an existing culvert is to be extended and the grade changes, a concrete collar as shown in *Figure 15 – Concrete Pipe Collar Detail* shall be used.

- e) Storm Drain Outlets: Erosion protection shall be provided at the outlet in accordance with the criteria presented in the Hydraulic Structures chapter of the USDCM (Volume 2). All storm drain outlets into open channels shall be constructed with a headwall and wing walls or a flared end section and toewall.

## **5.4 CULVERTS AND BRIDGES**

The hydraulic design of culverts bridges in Englewood shall be in accordance with the Culverts and Bridges chapter of the USDCM (Volume 2). Culverts are to be sized so that in the 2-year storm a minimum cleansing velocity of 3 fps is provided. The major storm design criteria are governed by the allowable street inundation as provided in Table 11. Culverts at a minimum shall be sized to convey the 5-year storm without overtopping and convey the difference between the 100-year storm and the allowable street overtopping, whichever is larger. Private driveway crossings over roadside ditches are required at a minimum to convey the 2-year storm.

All culverts shall be designed with headwalls and wing walls, or with flared end sections and toewalls at the inlet and outlet.

Conduit materials acceptable for use in culvert construction shall be in accordance with the criteria for storm drains, except for driveway culverts, which also allow corrugated metal pipe, and HDPE pipe. Driveway culverts shall be designed and installed to be resistant to damage from mowing equipment and errant vehicles.



## **SECTION 6.0 STORAGE**

### **6.1 GENERAL**

Detention basins constructed in the City shall be full spectrum detention facilities designed in accordance with the Storage chapter of USDCD (Volume 2). The first stage of these facilities, capturing and treating the water quality capture volume (WQCV), shall consist of extended detention basins, retention ponds, constructed wetland ponds, bioretention, or sand filter basins designed in accordance with USDCM (Volume 3).

### **6.2 DETENTION CRITERIA**

1) Landscaping Requirements

All detention basins shall be covered with a minimum of 6 inches topsoil and landscaped and/or revegetated. Detention basins when properly landscaped can be an attractive part of a development.

2) Maintenance

The Owner and subsequent owners, heirs, successors, and assigns shall maintain Stormwater detention ponds. In the event that the maintenance is not performed by said owner, the City of Englewood shall have the right to enter such area(s) and perform the necessary work, the cost of which said owner, heirs, successors, will be responsible for paying upon billing. Detention facilities shall be designed so that they are accessible to maintenance equipment as well as for removal of silt and debris and for repairs that may need to occur.

3) Drainage Plan Detention Facility Notes

The following notes shall be included on the “Drainage Plan Sheets” for detention facilities.

- a) Detention basin embankment shall have a minimum relative compaction of 95% at optimum moisture content of standard proctor. Provisions shall be made for watering of all native seeded areas until it is established.
- b) The detention basin embankment top and spillway crest shall be staked by the Developer to confirm that design grades are achieved prior to topsoil placement and landscaping.
- c) The detention facility volumes and all related drainage appurtenances (including basin boundaries) shall be determined and confirmed by a registered professional engineer prior to issuance of the certificate of occupancy for any structure on the site or in the Development.
- d) No building or structure will be constructed in the detention areas and no changes or alterations affecting the hydraulic characteristics of the detention areas will be made without the approval of the Public Works Director.
- e) Maintenance and operation of the detention areas will remain the responsibility of the property owner, if the property owner fails in this responsibility the City has the right to enter the property, maintain the detention areas, and require reimbursement for the costs that may be incurred.

4) Plat Detention Facility Notes

- a) The following notes shall be included on plats when stormwater detention basin areas are required:
  - i. The storm water detention area(s) shown hereon shall be constructed and maintained by the owner and subsequent owners, heirs, successors, and assigns. In the event that said construction and maintenance is not performed by said owner, the City of Englewood shall

- have the right to enter such area(s) and perform the necessary work, the cost of which said owner, heirs, successors, and assigns agrees to pay upon billing.
- ii. No building or structure will be constructed in the detention area(s) and no changes or alterations affecting the hydraulic characteristics of the detention area(s) will be made without the approval of the Public Works Director.
- b) For public stormwater detention or drainage easements, the following notes shall be included on the face of the plat:
- i. The storm water detention / (drainage easement(s)) shown hereon are hereby granted to the City. This (these) easement(s) is (are) being conveyed for the purposes of operation, repair, alteration, and maintenance of the storm water management system. The maintenance and operation of the said facility (facilities) shall be the responsibility of the City providing the design, construction, and maintenance criteria of the City are followed and the said facility (facilities) has (have) been accepted. The City has the right to enter the property for the purposes for which this (these) easement(s) has (have) been granted.
  - ii. No buildings, fills, excavations, structures, fences, or other alterations shall be constructed within a storm water detention (retention) / (drainage easement(s)) without the express written consent of the Public Works Director.

BY AUTHORITY

ORDINANCE NO. \_\_\_\_\_  
SERIES OF 2020

COUNCIL BILL NO. \_\_\_\_\_  
INTRODUCED BY COUNCIL  
MEMBER \_\_\_\_\_

**BILL FOR**

**AN ORDINANCE AUTHORIZING THE ADOPTION OF THE  
“ENGLEWOOD STORM DRAINAGE CRITERIA MANUAL”  
FOR THE REGULATION OF THE STORMWATER UTILITY  
WITHIN THE CITY OF ENGLEWOOD, COLORADO.**

**WHEREAS**, the Federal Clean Water Act requires stormwater discharges be authorized under a General Permit for Stormwater Discharge issued by the Colorado Department of Health and Environment, Water Quality Control Division;

**WHEREAS**, the Colorado Discharge Permit System, Regulation 61, states that the City is responsible for the quality of the stormwater discharged from its jurisdiction;

**WHEREAS**, the current “Englewood Storm Drainage Manual” was adopted by the Englewood City Council by passage of Ordinance No. 28, Series of 2005, and the regulations regarding stormwater discharge have been updated by the State of Colorado;

**WHEREAS**, the 2020 edition of the “Englewood Storm Drainage Manual” will supplant the 2005 manual in its entirety by the passage of this Ordinance;

**WHEREAS**, the rules and regulations regarding Stormwater Utility are authorized under Englewood Municipal Code 2000, 12-5-1;

**WHEREAS**, the City of Englewood has developed an updated “Englewood Storm Drainage Criteria Manual” for the purpose of granting the authority to address drainage and water quality mandates that have been imposed by the Environmental Protection Agency (EPA) and the Colorado Department of Health and Environment;

**WHEREAS**, the “Englewood Storm Drainage Criteria Manual” will affect large developments and will not be a burden on small lot developments in the City of Englewood;

**WHEREAS**, the “Englewood Storm Drainage Criteria Manual” gives the City, developers, design engineers and contractors concise directions on what is required to meet the intent of the EPA mandates, and

**WHEREAS**, the Englewood Water and Sewer Board recommended Council approval of the “Englewood Storm Drainage Criteria Manual” at their February 11, 2020 meeting.

**NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF ENGLEWOOD, COLORADO, AS FOLLOWS:**

Section 1. The City Council of the City of Englewood, Colorado hereby authorizes the adoption of the “Englewood Storm Drainage Criteria Manual”, as a requirement and regulation for the City of Englewood.

Section 2. Pursuant to Article V, Section 40, of the Englewood Home Rule Charter, the City Council has determined that this Ordinance shall be published by title because of its size. A copy of the Englewood Design and Construction Standards and Specifications is available in the Office of the Englewood City Clerk.

Introduced, read in full, and passed on first reading on the 18<sup>th</sup> day of February, 2020.

Published by Title as a Bill for an Ordinance in the City's official newspaper on the 20<sup>th</sup> day of February, 2020.

Published as a Bill for an Ordinance on the City's official website beginning on the 19<sup>th</sup> day of February, 2020 for thirty (30) days.

---

Linda Olson, Mayor

ATTEST:

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Stephanie Carlile, City Clerk

I, Stephanie Carlile, City Clerk of the City of Englewood, Colorado, hereby certify that the above and foregoing is a true copy of the Bill for an Ordinance introduced, read in full, and passed on first reading on the 18<sup>th</sup> day of February, 2020.

---

Stephanie Carlile

**PRELIMINARY REVIEW CHECKLIST**

Developer or Design Engineer:

The drainage report for the location described below has been received and lacks the required information noted. All the missing information must be provided before this report will be accepted for review. If you have any questions, call the City Review Engineer. This checklist must be returned with your submittal.

Project Name: \_\_\_\_\_  
 Site Address: \_\_\_\_\_  
 Subdivision Name: \_\_\_\_\_  
 Preparer: \_\_\_\_\_  
 Engineer: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 E-mail: \_\_\_\_\_

Date Submitted: \_\_\_\_\_  
 City Review Engineer: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 e-mail: \_\_\_\_\_

| <b>I. TITLE PAGE</b>   | <b>Missing</b> | <b>Present</b> | <b>Not Required</b> |
|--|----------------|----------------|---------------------|
| A. Type of Report<br>(Preliminary, Final, Flood Plain Development) |                |                |                     |
| B. Project Name/Address  |                |                |                     |
| C. Preparer: Name, Firm, Date                                      |                |                |                     |
| <b>II. BODY OF REPORT</b>  |                |                |                     |
| A. Legible   |                |                |                     |
| B. Historic Initial and Major Storm Analysis                       |                |                |                     |
| E. Soil and Water Table Data                                       |                |                |                     |
| F. Peak Discharge Table  |                |                |                     |
| G. Developed Initial and Major Storm Analysis                      |                |                |                     |
| H. Offsite Runoff Impacts Analysis                                 |                |                |                     |
| I. Detention Pond Storage Requirements Discussion                  |                |                |                     |
| J. Permanent Stormwater Quality (Post Construction)                |                |                |                     |
| <b>III. APPENDICES</b>   |                |                |                     |
| A. Legible   |                |                |                     |
| B. Computations  |                |                |                     |
| 1. Degree of Imperviousness  |                |                |                     |
| 2. Time of Concentration   |                |                |                     |
| 3. Peak Discharge Calculations                                     |                |                |                     |
| 4. Detention Pond Storage Requirements                             |                |                |                     |
| 5. Water Quality Capture Volume Requirements                       |                |                |                     |
| C. Map of Total Drainage Basin                                     |                |                |                     |
| D. Rainfall Curves   |                |                |                     |
| E. Design Nomographs   |                |                |                     |
|  |                |                |                     |
|  |                |                |                     |
|  |                |                |                     |
|  |                |                |                     |

Preliminary Review Checklist  
Appendix B  
February, 2020

|  | Missing | Present | Not<br>Required |
|--|---------|---------|-----------------|
| <b>IV. DRAINAGE PLAN SHEET</b>   |         |         |                 |
| A. Legible   |         |         |                 |
| B. Location Map  |         |         |                 |
| C. Site Location Shown   |         |         |                 |
| D. Legend  |         |         |                 |
| E. Benchmark Reference   |         |         |                 |
| F. North Arrow   |         |         |                 |
| G. Scale   |         |         |                 |
| H. Date Prepared and Revision Dates  |         |         |                 |
| Existing and Proposed Contours (2' Max. Interval)                            |         |         |                 |
| J. Drainage Basin and Sub-Basin Boundaries<br>(Historic and Developed)       |         |         |                 |
| 1. Acreage   |         |         |                 |
| 2. Imperviousness  |         |         |                 |
| 3. Peak Discharge Data Table   |         |         |                 |
| a. Historic Initial and Major  |         |         |                 |
| b. Developed Initial and Major   |         |         |                 |
| 4. Offsite drainage flow patterns and impacts.                               |         |         |                 |
| K. Design Point Flow Data Shown (Initial and Major)                          |         |         |                 |
| L. Street Names and Grades   |         |         |                 |
| M. Property Lines & ROW Lines  |         |         |                 |
| N. Easements   |         |         |                 |
| O. Storm Sewer Layout with Sizes   |         |         |                 |
| P. Storm Inlet Locations   |         |         |                 |
| Q. Cross Pan Locations   |         |         |                 |
| R. Open Channel Drainageways   |         |         |                 |
| S. Detention Pond Location(s)  |         |         |                 |
| T. Permanent Stormwater Quality (Post Construction)<br>Facility Location (s) |         |         |                 |
| U. Location and Elevation of Outfall Points                                  |         |         |                 |
| 1. Historic Initial and Major  |         |         |                 |
| 2. Developed Initial and Major   |         |         |                 |
| V. Irrigation Ditch  |         |         |                 |
| W. Flood Plain and Floodway Information                                      |         |         |                 |
| X. Critical Minimum Finish Floor Elevations                                  |         |         |                 |
| X. <i>Standard Notes</i>   |         |         |                 |
|  |         |         |                 |
|  |         |         |                 |
|  |         |         |                 |
|  |         |         |                 |

## V. OTHER

**FINAL DRAINAGE REPORT REVIEW CHECKLIST**

Developer or Design Engineer:

The drainage report for the location described below has been received and lacks the required information noted. All the missing information must be provided before this report will be accepted for review. If you have any questions, call the City Review Engineer. This checklist must be returned with your submittal.

Project Name: \_\_\_\_\_  
 Site Address: \_\_\_\_\_  
 Subdivision Name: \_\_\_\_\_  
 Preparer: \_\_\_\_\_  
 Engineer: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 e-mail: \_\_\_\_\_

Date Submitted: \_\_\_\_\_  
 City Review Engineer: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 e-mail: \_\_\_\_\_

| <b>I. TITLE PAGE</b>   | <b>Missing</b> | <b>Present</b> | <b>Not Required</b> |
|--|----------------|----------------|---------------------|
| A. Type of Report<br>(Preliminary, Final, Flood Plain Development) |                |                |                     |
| B. Project Name  |                |                |                     |
| C. Preparer: Name, Firm, Date                                      |                |                |                     |
| <b>II. BODY OF REPORT</b>  |                |                |                     |
| A. Legible   |                |                |                     |
| B. Historic Initial and Major Storm Analysis                       |                |                |                     |
| E. Soil and Water Table Data                                       |                |                |                     |
| F. Peak Discharge Table  |                |                |                     |
| G. Developed Initial and Major Storm Analysis                      |                |                |                     |
| H. Offsite Runoff Impacts Analysis                                 |                |                |                     |
| I. Detention Pond Storage Requirements Discussion                  |                |                |                     |
| J. Permanent Stormwater Quality (Post Construction)                |                |                |                     |
| <b>III. APPENDICES</b>   |                |                |                     |
| A. Legible   |                |                |                     |
| B. Computations  |                |                |                     |
| 1. Degree of Imperviousness  |                |                |                     |
| 2. Time of Concentration   |                |                |                     |
| 3. Peak Discharge Calculations                                     |                |                |                     |
| 4. Street Capacity Analysis  |                |                |                     |
| 5. Storm Inlet Design Analysis                                     |                |                |                     |
| 6. Pipe Sizing Calculations  |                |                |                     |
| 7. Open Channel Calculations                                       |                |                |                     |
| 8. Detention Pond Storage Requirements                             |                |                |                     |
| 9. Pond Outlet Design Calculations                                 |                |                |                     |
| 10. Pond Volume Provided Calculations                              |                |                |                     |
| 11. Permanent Stormwater Quality (Post Construction) Calculations  |                |                |                     |
| C. Map of Total Drainage Basin                                     |                |                |                     |
| D. Rainfall Curves   |                |                |                     |
| E. Design Nomographs   |                |                |                     |



Final Drainage Report Checklist  
Appendix C  
February, 2020

| IV. DRAINAGE PLAN SHEET   | Missing | Present | Not Required |
|---|---------|---------|--------------|
| A. Legible  |         |         |              |
| B. Location Map   |         |         |              |
| C. Site Location Shown  |         |         |              |
| D. Legend   |         |         |              |
| E. Benchmark Reference  |         |         |              |
| F. North Arrow  |         |         |              |
| G. Scale  |         |         |              |
| H. Date Prepared and Revision Dates   |         |         |              |
| I. Ex. and Proposed Contours (2' max interval)<br>(50' beyond project limits) |         |         |              |
| J. Drainage Basin and Sub-Basin Boundaries<br>(Historic and Developed)        |         |         |              |
| 1. Acreage  |         |         |              |
| 2. Imperviousness   |         |         |              |
| 3. Peak Discharge Data Table  |         |         |              |
| a. Historic Initial and Major   |         |         |              |
| b. Developed Initial and Major  |         |         |              |
| 4. Offsite drainage flow patterns and impacts.                                |         |         |              |
| K. Design Point Flow Data Shown (Initial and Major)                           |         |         |              |
| L. Street Names and Grades  |         |         |              |
| M. Property Lines & ROW Lines   |         |         |              |
| N. Easements  |         |         |              |
| O. Storm Sewer Layout with Sizes  |         |         |              |
| P. Storm Inlet Locations  |         |         |              |
| Q. Cross Pan Locations  |         |         |              |
| R. Open Channel Drainageways  |         |         |              |
| S. Detention Pond Location(s)   |         |         |              |
| 1. WQCV, EURV and 100 yr Volumes  |         |         |              |
| 2. WQCV, EURV and 100 yr Volume Elevations                                    |         |         |              |
| 3. Outlet Details   |         |         |              |
| 4. Emergency Overflow   |         |         |              |
| T. Permanent Stormwater Quality (Post Construction)                           |         |         |              |
| U. Location and Elevation of Outfall Points                                   |         |         |              |
| 1. Historic Initial and Major   |         |         |              |
| 2. Developed Initial and Major  |         |         |              |
| V. Irrigation Ditch   |         |         |              |
| W. Flood Plain and Floodway Information                                       |         |         |              |
| X. Critical Minimum Finish Floor Elevations                                   |         |         |              |
| X. Standard Notes   |         |         |              |
|   |         |         |              |
|   |         |         |              |
|   |         |         |              |

Final Drainage Report Checklist  
Appendix C  
February, 2020

## V. OTHER

**SMALL LOT DEVELOPMENT FORM**

This form shall be used for the development and/or redevelopment of infill lots that are less than 0.5 acre in size. Attach any additional information as required.

City of Englewood  
Engineering Services  
1000 Englewood Parkway  
Englewood, CO 80110  
303.762.2500  
[www.engagewoodco.gov](http://www.engagewoodco.gov)

**Project Name:** \_\_\_\_\_

**Site Address:** \_\_\_\_\_

**Subdivision Name:** \_\_\_\_\_

**Preparer:**

**Firm:** \_\_\_\_\_ **Engineer:** \_\_\_\_\_

**Phone:** \_\_\_\_\_ **e-mail:** \_\_\_\_\_

**Site Description:** Address existing conditions such as topography, present land use, existing structures, and pavement areas. \_\_\_\_\_

**Proposed Project Description:** Address any and all proposed changes and land use. \_\_\_\_\_

**Existing Drainage Pattern:** Address flows, direction of flows, concentrated vs. sheet flows, where do flows go, any offsite flows, irrigation ditches, existing drainage structures, and flood plain or flood hazard issues. \_\_\_\_\_

**Proposed Drainage Pattern:** Describe any proposed changes to the existing pattern or drainage system. \_\_\_\_\_

**Weighted Impervious Calculations:**

| <u>Existing Site</u>            | <b>A</b><br>Impervious (%) | <b>B</b><br>Existing<br>Area (sf)                      | <b>C</b><br>Existing<br>Imperviousness<br>(AxB) |
|---------------------------------|----------------------------|--|---|
| <b><u>Impervious Areas:</u></b> |                            |  |   |
| Roof Areas                      | 90%                        |  |   |
| Paved Areas                     | 100%                       |  |   |
| Other                           |                            |  |   |
| <b><u>Pervious Areas:</u></b>   |                            |  |   |
| Gravel Areas                    | 40%                        |  |   |
| Native Areas                    | 0%                         |  |   |
| Grass Landscape Areas           | 0%                         |  |   |
| Other                           |                            |  |   |
|                                 |                            | Sum B=   | Sum C=  |
|                                 |                            | <b>Existing<br/>Imperviousness=<br/>(Sum C/Sum B)</b>  | <b>%</b>  |
| <b><u>Developed Site</u></b>    | <b>A</b>                   | <b>B</b>   | <b>C</b>  |
| <b><u>Impervious Areas:</u></b> | Impervious (%)             | Existing<br>Area (sf)                                  | Existing<br>Imperviousness<br>(AxB)             |
| Roof Areas                      | 90%                        |  |   |
| Paved Areas                     | 100%                       |  |   |
| Other                           |                            |  |   |
| <b><u>Pervious Areas:</u></b>   |                            |  |   |
| Gravel Areas                    | 40%                        |  |   |
| Native Areas                    | 0%                         |  |   |
| Grass Landscape Areas           | 0%                         |  |   |
| Other                           |                            |  |   |
|                                 |                            | Sum B=   | Sum C=  |
|                                 |                            | <b>Developed<br/>Imperviousness=<br/>(Sum C/Sum B)</b> | <b>%</b>  |

**Development Impact Analysis:** Address the beneficial and detrimental impacts that the proposed development/redevelopment will have.

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**Best Management Practices Plan:** Evaluate the possible pollution sources that are common for the proposed type of development and indicate the controls recommended to mitigate adverse impacts.

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**Site Plan Provided:**

- |   |                                      |   |  |   |
|---|--------------------------------------|---|--|---|
| <input type="checkbox"/> Scale                  | <input type="checkbox"/> North Arrow | <input type="checkbox"/> Property Lines       | <input type="checkbox"/> Easements                               | <input type="checkbox"/> Existing Utilities |
| <input type="checkbox"/> Adjacent Streets       |                                      | <input type="checkbox"/> Drainage Flow Arrows | <input type="checkbox"/> Existing and Proposed Site Improvements |   |
| <input type="checkbox"/> Ex & Proposed Contours |                                      | <input type="checkbox"/> Benchmark            |  |   |

**DRAINAGE CONSTRUCTION PLAN CHECKLIST**

Project Name: \_\_\_\_\_  
 Site Address: \_\_\_\_\_  
 Subdivision Name: \_\_\_\_\_  
 Preparer: \_\_\_\_\_  
 Engineer: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 e-mail: \_\_\_\_\_

Date Submitted: \_\_\_\_\_  
 Review Comments Sent: \_\_\_\_\_  
 2nd Submittal: \_\_\_\_\_  
 Review Comments Sent: \_\_\_\_\_  
 3rd Submittal: \_\_\_\_\_  
 Date Approved: \_\_\_\_\_

|   | Missing | Present | Not Required |
|---|---------|---------|--------------|
| <b>I. PLAN</b>                              |         |         |              |
| A. Title Block                              |         |         |              |
| B. Scale (Horizontal and Vertical)          |         |         |              |
| C. North Arrow                              |         |         |              |
| D. Location Map with Site Location Shown    |         |         |              |
| E. Legend                                   |         |         |              |
| F. Plan Date and Revisions                  |         |         |              |
| G. Professional Engineer and/or Firm        |         |         |              |
| H. PE Seal                                  |         |         |              |
| I. Specifications                           |         |         |              |
| J. Drawing Numbers                          |         |         |              |
| K. Notes                                    |         |         |              |
| L. Location and elevation of USGS Benchmark |         |         |              |
| <b>II. Basic Data</b>                       |         |         |              |
| A. Street Information                       |         |         |              |
| 1. Street Names                             |         |         |              |
| 2. Grades and Cross Slopes                  |         |         |              |
| 3. ROW/Street Dimensions                    |         |         |              |
| B. Soil and Water Table Information         |         |         |              |
| 1. Test Hole Locations                      |         |         |              |
| 2. Classification of Major Soil Types       |         |         |              |
| C. Property Line/ROW Lines                  |         |         |              |
| D. Easements                                |         |         |              |
| E. Structures                               |         |         |              |
| F. Walks, Drives and Parking                |         |         |              |
| G. Proposed and Existing Contours           |         |         |              |
| H. Critical Spot Elevations and Slopes      |         |         |              |
| I. Retaining Walls                          |         |         |              |
| J. Irrigation Ditches                       |         |         |              |
| K. Flood Plain Limits                       |         |         |              |
|   |         |         |              |
|   |         |         |              |

Drainage Construction Plan Checklist  
Appendix E  
February, 2020

|  | Missing | Present | Not Required |
|--|---------|---------|--------------|
| <b>II. HYDROLOGY</b>                                     |         |         |              |
| B. Stormwater WQCV, EURV and 100 Year Storage Data       |         |         |              |
| 1. Required Volumes                                      |         |         |              |
| 2. Provided Volumes                                      |         |         |              |
| 3. WQCV, EURV and 100 Yr Water Surface Elevations        |         |         |              |
| 4. Pond Release Rates                                    |         |         |              |
| K. Storm Inlets (Labels consistent with drainage report) |         |         |              |
| 1. Type  |         |         |              |
| 2. Size  |         |         |              |
| 3. Flowline and Invert Elevations                        |         |         |              |
| 4. Flow Data (flow intercepted and by-passed)            |         |         |              |
| L. Storm Sewers  |         |         |              |
| 1. Pipe Capacity and Design Flow                         |         |         |              |
| 2. Stationing  |         |         |              |
| 3. Pipe Size and Material                                |         |         |              |
| 4. Pipe Lengths  |         |         |              |
| 5. Profiles  |         |         |              |
| 6. Hydraulic Grade Lines                                 |         |         |              |
| 7. Invert Elevations and Grades                          |         |         |              |
| 8. Manholes, Inlets                                      |         |         |              |
| 9. Trench and Bedding Details                            |         |         |              |
| M. Existing and Proposed Utilities                       |         |         |              |
| 1. Location and Depth                                    |         |         |              |
| a. Water   |         |         |              |
| b. Gas   |         |         |              |
| c. Electric  |         |         |              |
| d. Sanitary Sewer  |         |         |              |
| e. Fiber Optics  |         |         |              |
| f. Cable TV  |         |         |              |
| 2. Utility Notification Note & Phone #                   |         |         |              |
| 3. Potential Conflicts Noted and Identified              |         |         |              |

Drainage Construction Plan Checklist  
Appendix E  
February, 2020

|                               | Missing | Present | Not Required |
|-------------------------------|---------|---------|--------------|
| N. Detention Pond             |         |         |              |
| 1. Contours                   |         |         |              |
| 2. Outlet Details             |         |         |              |
| 3. Lining Details             |         |         |              |
| 4. Key Elevations Noted       |         |         |              |
| 5. Minimum Freeboard Provided |         |         |              |
| 6. Emergency Overflow         |         |         |              |
| O. Open Channels              |         |         |              |
| 1. Stationing                 |         |         |              |
| 2. Cross-Sections Provided    |         |         |              |
| 3. Trickle Channel            |         |         |              |
| 4. Lining Details             |         |         |              |
| 5. Max and Min Velocities     |         |         |              |
| 6. Grades                     |         |         |              |
| 7. Profile                    |         |         |              |
| 8. Freeboard Requirements Met |         |         |              |
| P. Special Structures         |         |         |              |
| 1. Plan                       |         |         |              |
| 2. Elevations                 |         |         |              |
| 3. Design Details             |         |         |              |
| Q. Standard Notes             |         |         |              |
|                               |         |         |              |
| <b>IV. OTHER</b>              |         |         |              |
|                               |         |         |              |
|                               |         |         |              |
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|                               |         |         |              |
|                               |         |         |              |
|                               |         |         |              |
|                               |         |         |              |
| City Review Engineer:         | Date:   | Phone:  |              |
| e-mail:                       |         |         |              |

**STORMWATER QUALITY MANAGEMENT PLAN REQUIREMENTS**

Developer or Design Engineer:

The SWMP report for the location described below has been received and lacks the required information noted. All the missing information must be provided before this report will be accepted for review. If you have any questions, call the City Review Engineer. This checklist must be returned with your submittal.

Project Name: \_\_\_\_\_  
 Site Address: \_\_\_\_\_  
 Subdivision Name: \_\_\_\_\_  
 Preparer: \_\_\_\_\_  
 Engineer: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 e-mail: \_\_\_\_\_

Date Submitted: \_\_\_\_\_  
 City Review Engineer: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 e-mail: \_\_\_\_\_

**Sites one (1) acre and larger must meet additional requirements per the Colorado Department of Health and Environment, Water Quality.**

| <b>I. TITLE PAGE</b>                                       | <b>Missing</b> | <b>Present</b> | <b>Not Required</b> |
|--|----------------|----------------|---------------------|
| A. Stormwater Management Plan                              |                |                |                     |
| B. Project Name/Address                                    |                |                |                     |
| C. Preparer: Name, Firm, Date                              |                |                |                     |
| D. Engineer's Stamp/Signature                              |                |                |                     |
| <b>II. BODY OF REPORT</b>                                  |                |                |                     |
| A. Legible   |                |                |                     |
| B. Description of Project                                  |                |                |                     |
| 1. Location  |                |                |                     |
| 2. General Description                                     |                |                |                     |
| 3. Topography, Soil Types, Vegetation                      |                |                |                     |
| 4. Site Area   |                |                |                     |
| 5. Disturbed Area  |                |                |                     |
| 6. Cut/Fill Volumes  |                |                |                     |
| 7. Receiving Waters  |                |                |                     |
| 8. City of Englewood Drainage Basin                        |                |                |                     |
| 9. Schedule of Major Construction Activities               |                |                |                     |
| 10. Contact Information for Qualified Stormwater Manager   |                |                |                     |
| C. Potential Pollution Sources                             |                |                |                     |
| D. Erosion and Sediment Control Measures                   |                |                |                     |
| E. Materials Handling and Spill Prevention                 |                |                |                     |
| F. Inspection Scheduling and Reporting                     |                |                |                     |
| G. Corrective Action                                       |                |                |                     |
| H. Final Stabilization and Long Term Stormwater Management |                |                |                     |



Stormwater Management Plan  
Appendix F  
February, 2020

|  | Missing | Present | Not Required |
|--|---------|---------|--------------|
| <b>III. APPENDICES</b>                           |         |         |              |
| A. Legible                                       |         |         |              |
| B. Computations                                  |         |         |              |
| 1. Diversion Swale                               |         |         |              |
| 2. Sediment Pond                                 |         |         |              |
| 3. Other;  |         |         |              |
| 4. Other   |         |         |              |
| C. Inspection Report Forms                       |         |         |              |
| <b>IV. Plan</b>                                  |         |         |              |
| A. Title Block                                   |         |         |              |
| B. Scale   |         |         |              |
| C. North Arrow                                   |         |         |              |
| D. Location Map with Site Location Shown         |         |         |              |
| E. Legend  |         |         |              |
| F. Plan Date and Revisions                       |         |         |              |
| G. Professional Engineer and/or Firm             |         |         |              |
| H. PE Seal                                       |         |         |              |
| I. Specifications                                |         |         |              |
| J. Drawing Numbers                               |         |         |              |
| K. Notes   |         |         |              |
| L. Location and elevation of USGS Benchmark      |         |         |              |
| M. Owner's Acknowledgement                       |         |         |              |
| N. Site Plan                                     |         |         |              |
| 1. Property/ROW Lines                            |         |         |              |
| 2. Street Names                                  |         |         |              |
| 3. Structures                                    |         |         |              |
| 4. Walks, Drives and Parking                     |         |         |              |
| 5. Retaining Walls                               |         |         |              |
| 6. Storm Sewer Pipes, Inlets and Manholes        |         |         |              |
| 7. Floodplain Limits                             |         |         |              |
| O. BMP Legend                                    |         |         |              |
| P. BMP Notes                                     |         |         |              |
| Q. Stormwater Data Block                         |         |         |              |
| 1. Total Area/Disturbed Area                     |         |         |              |
| 2. Cut/Fill Volumes                              |         |         |              |
| 3. City of Englewood Drainage Basin              |         |         |              |
| 4. Receiving Waters                              |         |         |              |
| Q. Project/BMP Schedule                          |         |         |              |
| R. BMP Symbols Labeled & Dimensioned             |         |         |              |
| S. Limits of Construction                        |         |         |              |
| T. Flow Arrows                                   |         |         |              |
| U. Existing and Proposed Contours at 1' Interval |         |         |              |
| V. Standard Details                              |         |         |              |

## V. OTHER

## APPENDIX G

## CITY OF ENGLEWOOD STANDARD FORM-1

### TIME OF CONCENTRATION

SHEET NO: \_\_\_\_\_

PROJECT: \_\_\_\_\_

JOB NO: \_\_\_\_\_

CALCULATED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

DESIGN STORM \_\_\_\_\_

[illegible]

## STORM DRAINAGE SYSTEM DESIGN

SHEET NO: \_\_\_\_\_

PROJECT: \_\_\_\_\_

JOB NO: \_\_\_\_\_

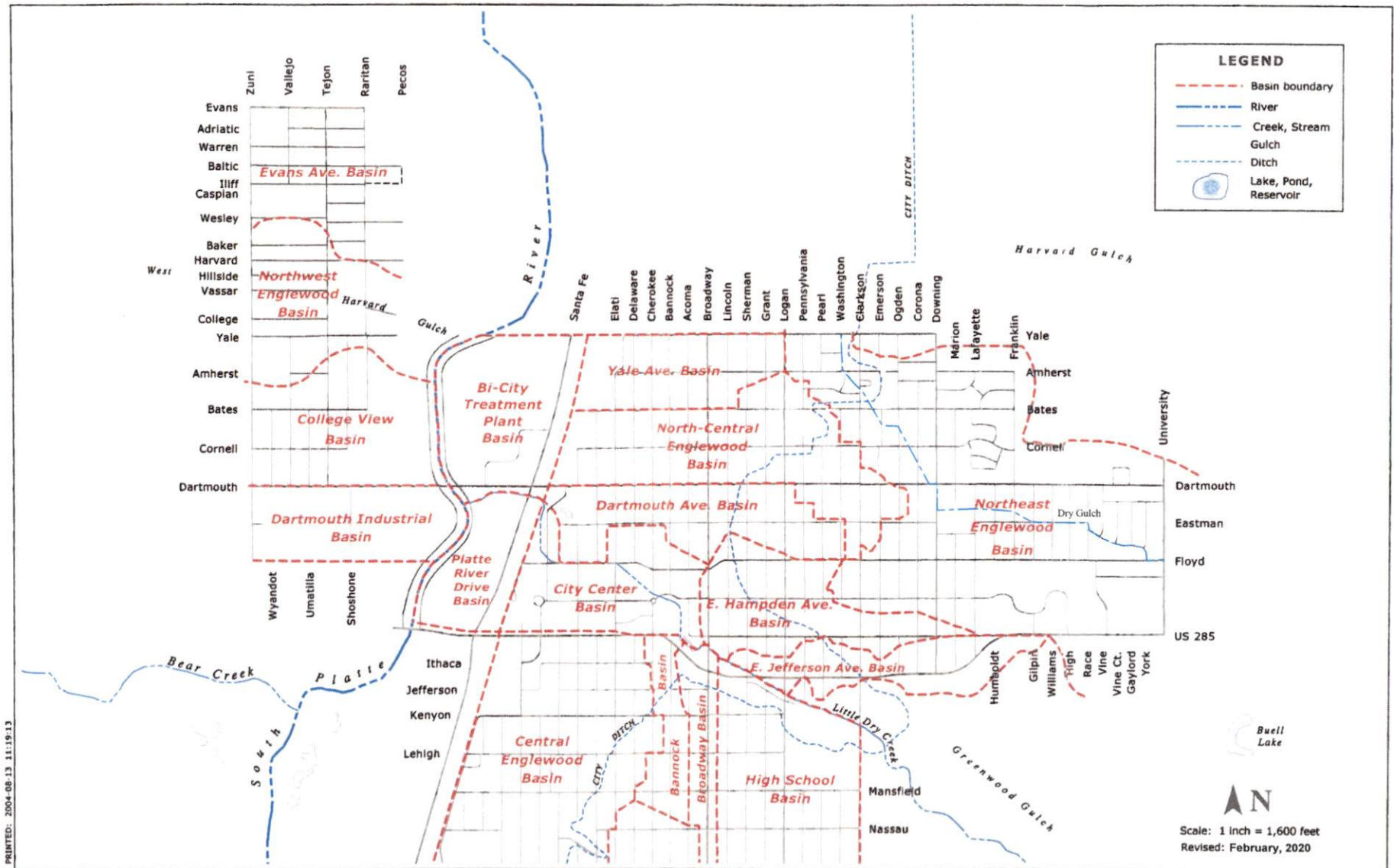
CALCULATED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

**DESIGN STORM:** \_\_\_\_\_

[illegible]

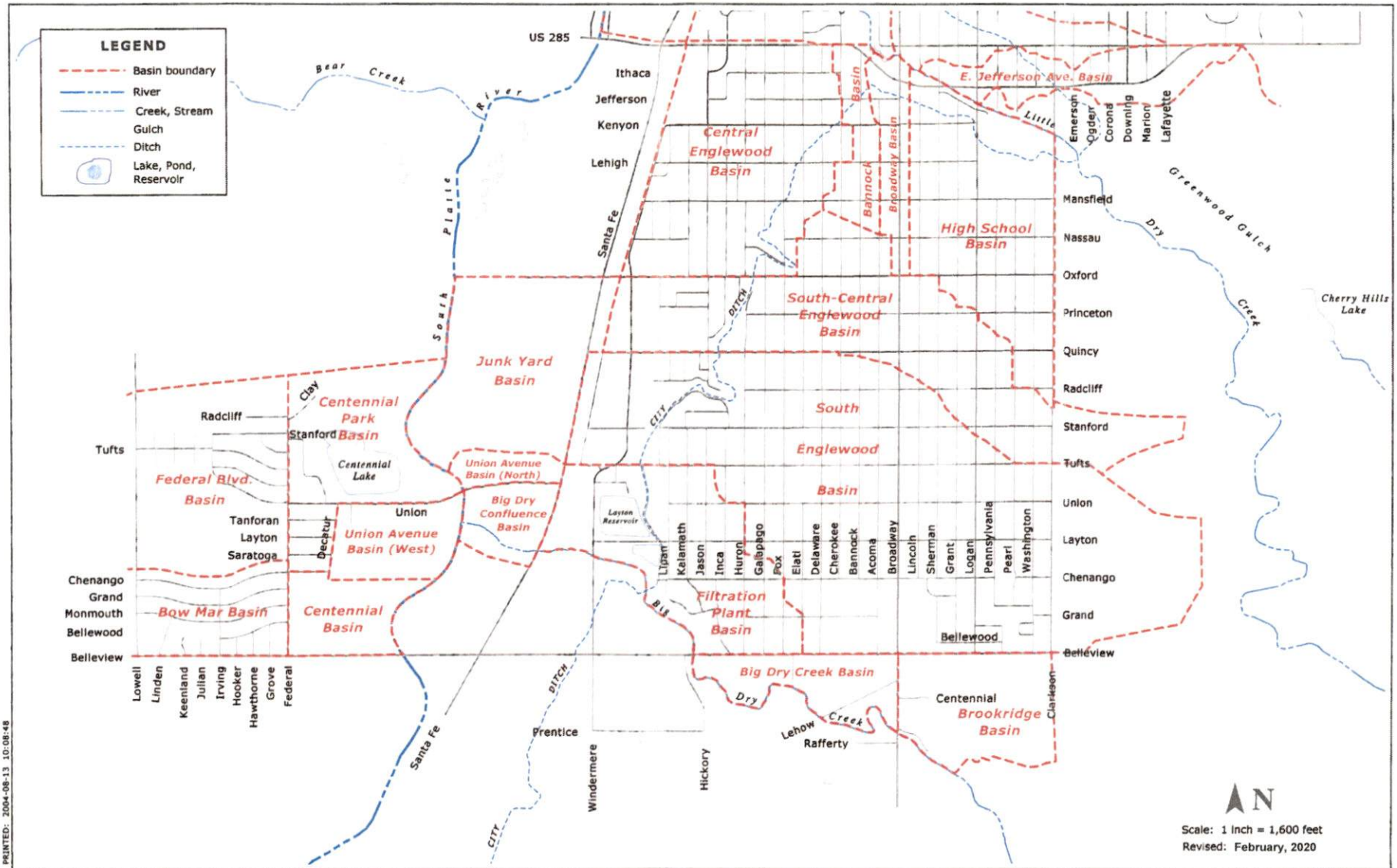
CITY OF ENGLEWOOD  
Storm Drainage Basins

FIGURE 1A

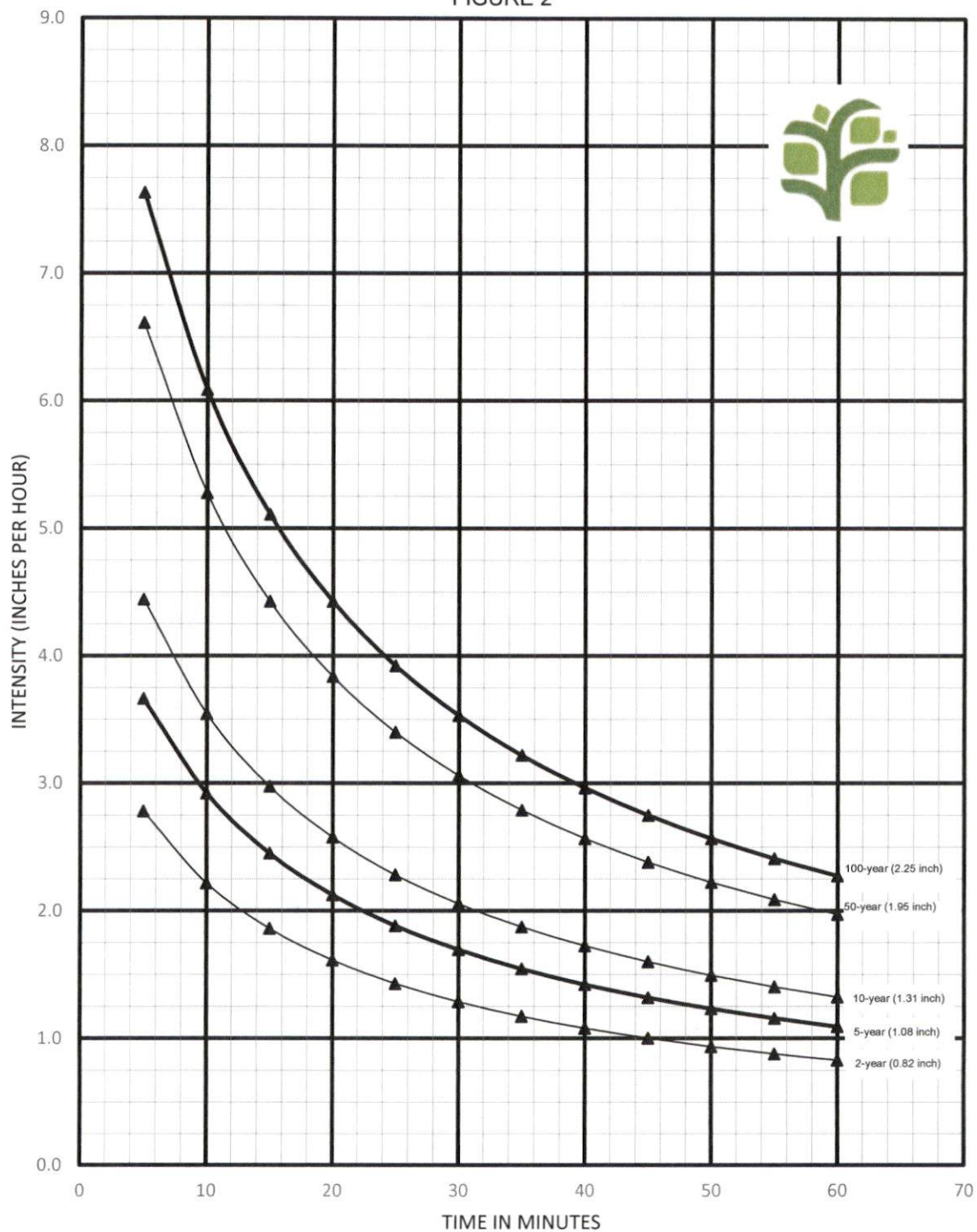


CITY OF ENGLEWOOD  
**Storm Drainage Basins**

FIGURE 1B



RAINFALL INTENSITY - DURATION CURVES  
FIGURE 2

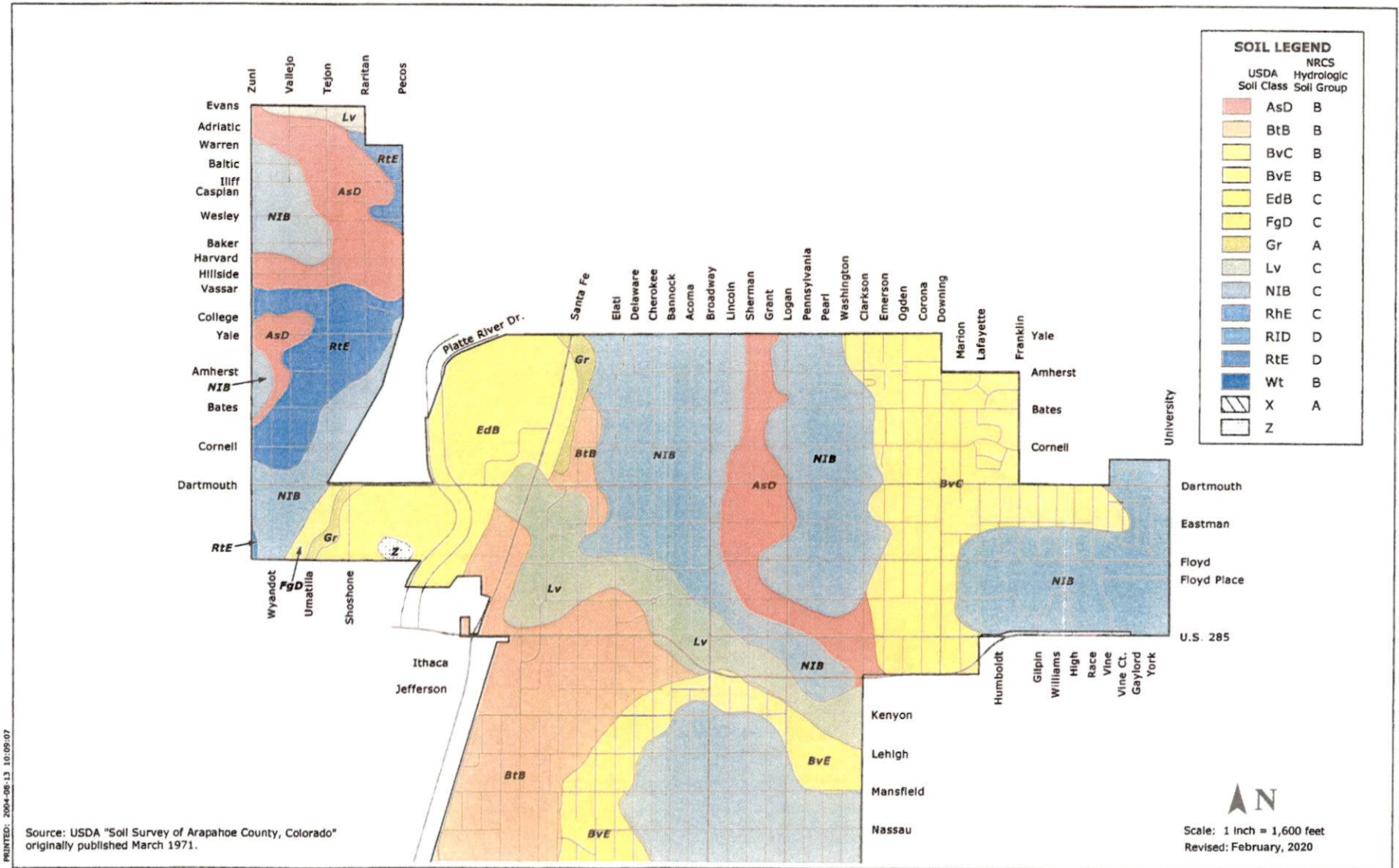


February, 2020



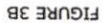
# CITY OF ENGLEWOOD Soil Classifications

FIGURE 3A




















Source: USDA "Soil Survey of Arapahoe County, Colorado" originally published March 1971.



CITY OF ENGLEWOOD  
**Soil Classifications**

**Soil Legend**

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|   |            |  |
|---|------------|--|
|    | <b>AsD</b> | Ascalon sandy loam, 5% to 9% slopes                                |
|    | <b>BtB</b> | Bresser loam, gravelly subsoil variant, 1% to 3% slopes            |
|    | <b>BvC</b> | Bresser-Truckton sandy loams, 3% to 5% slopes                      |
|    | <b>BvE</b> | Bresser-Truckton sandy loams, 5% to 20% slopes                     |
|    | <b>EdB</b> | Edgewater loam, 0% to 3% slopes                                    |
|    | <b>FgD</b> | Fondis-Ascalon, gravelly subsoil variant, complex, 1% to 9% slopes |
|    | <b>Gr</b>  | Gravelly land  |
|   | <b>Lv</b>  | Loamy alluvial land  |
|  | <b>NIB</b> | Nunn Loam, 0% to 3% slopes   |
|  | <b>RhE</b> | Renohill-Buick loams, 9% to 20% slopes                             |
|  | <b>RID</b> | Renohill-Litle clay loams, 3% to 9% slopes                         |
|  | <b>RtE</b> | Renohill-Litle-Thedalund complex, 9% to 30% slopes                 |
|  | <b>Wt</b>  | Wet alluvial land  |
|  | <b>X</b>   | Gravel pit   |
|  | <b>Z</b>   | Unable to determine classification from source map                 |

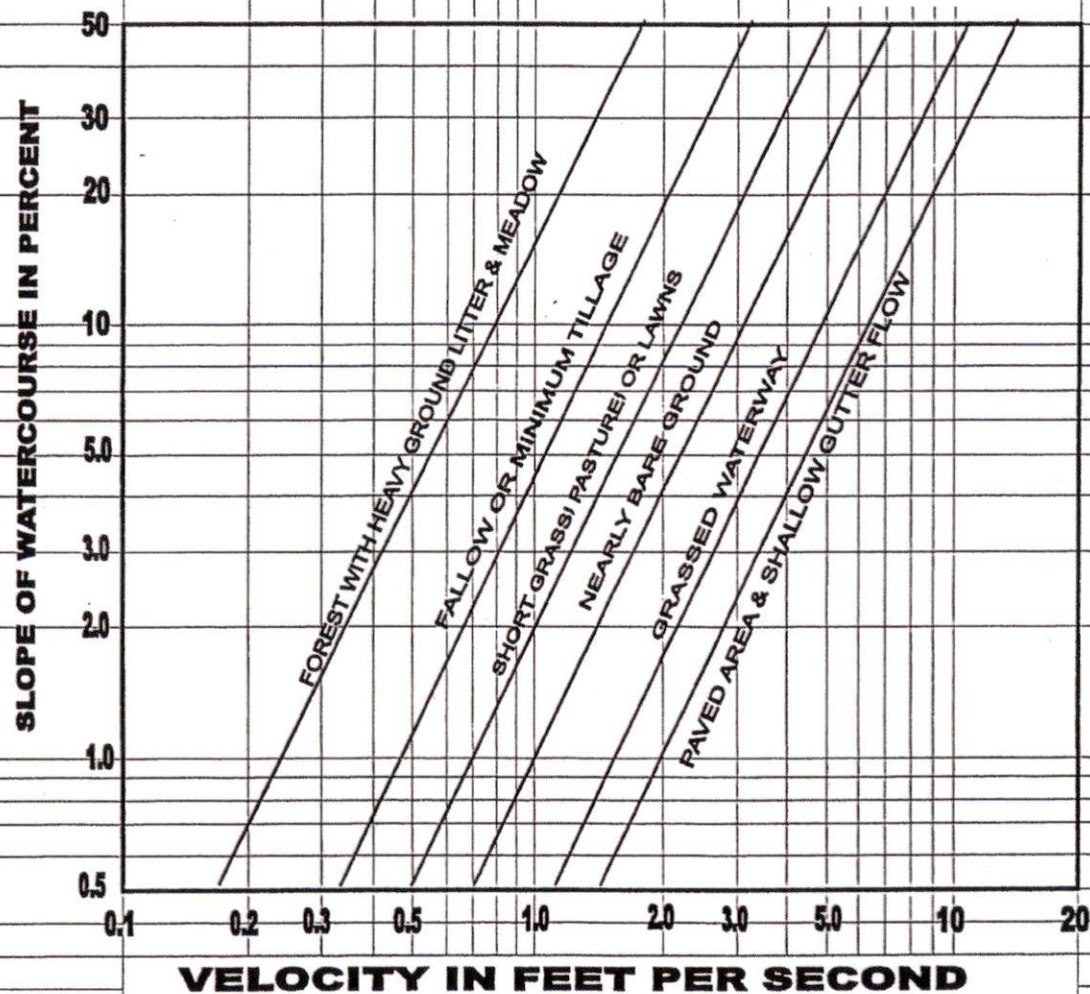
**Notes:**

Map source: USDA "Soil Survey of Arapahoe County, Colorado" originally published March 1971.

FIGURE 3C

**Figure 4**

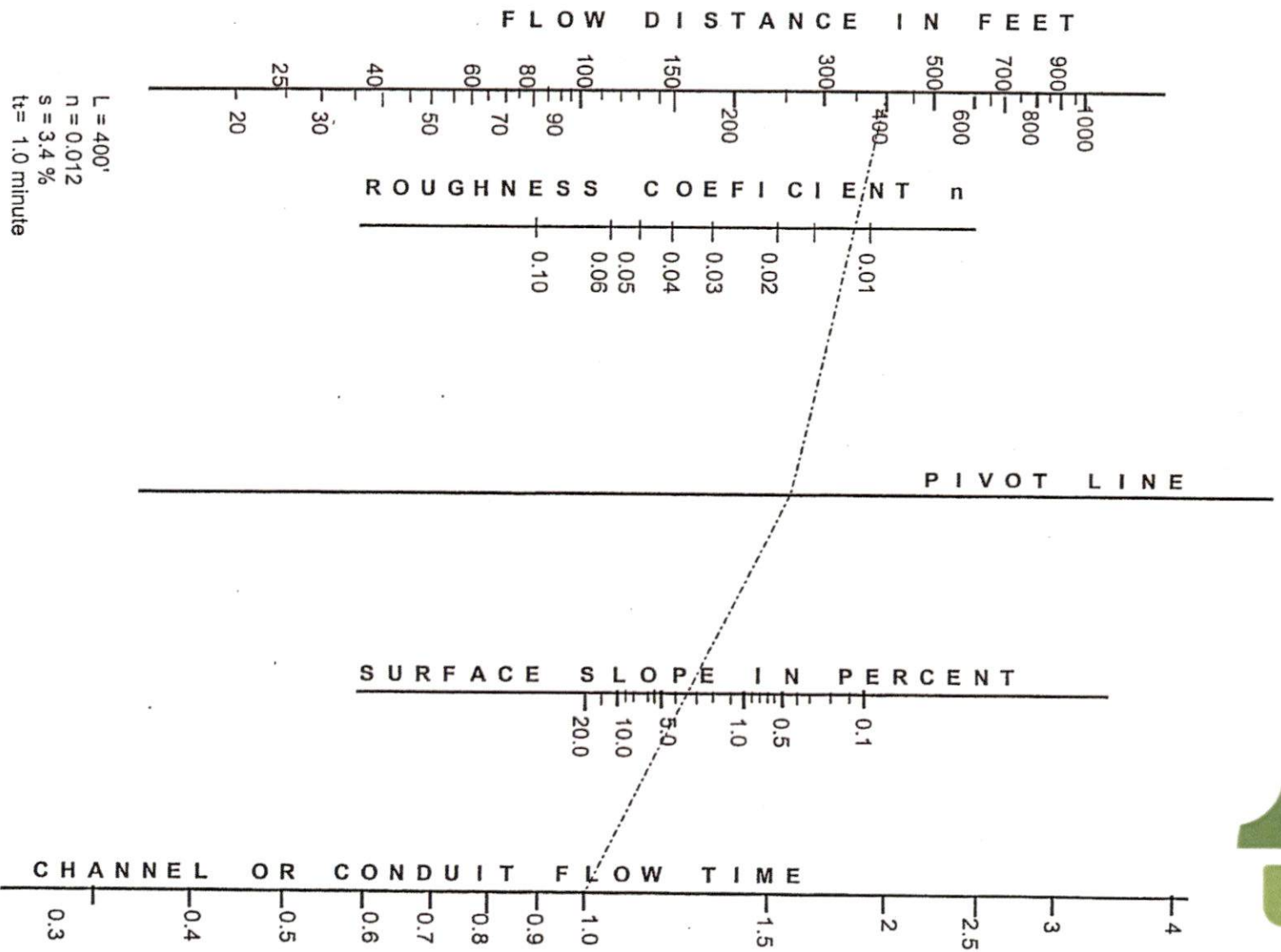
**GROUND COVER VELOCITIES**





**Figure 5**

CHANNEL OR CONDUIT FLOW TIME NOMOGRAPH



$L = 400'$   
 $n = 0.012$   
 $s = 3.4\%$   
 $t = 1.0 \text{ minute}$

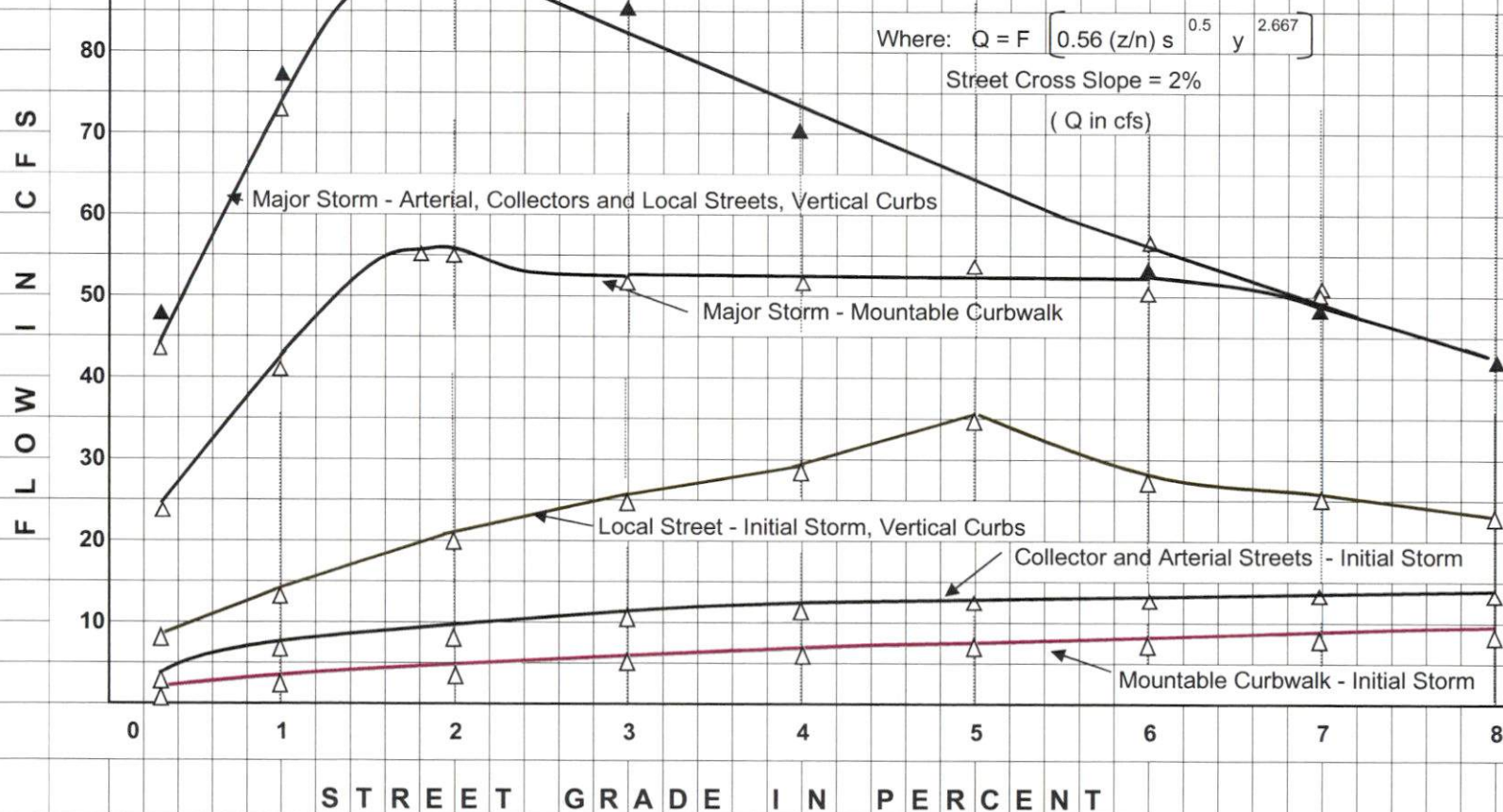




**Figure 6**

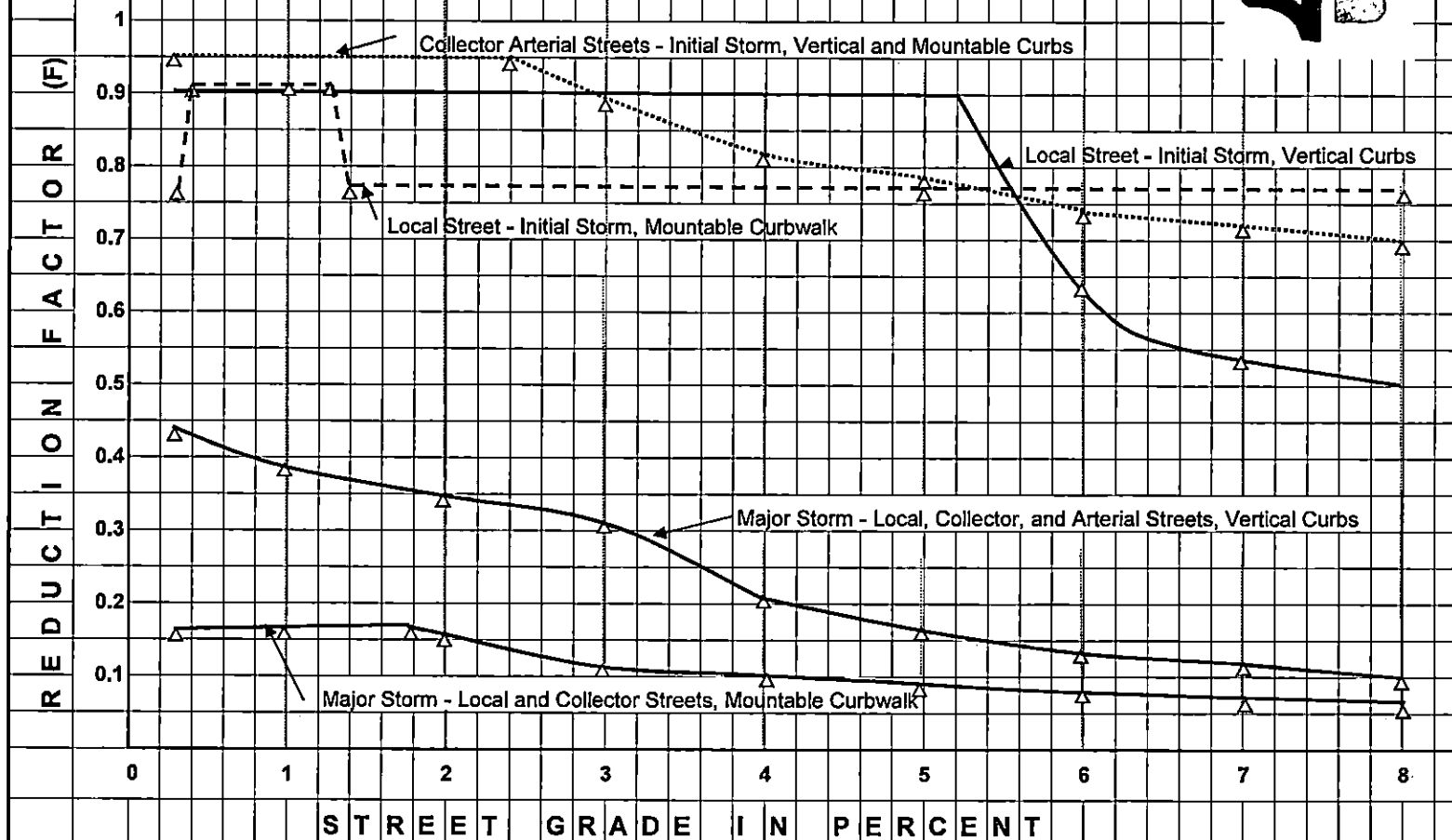
**STREET FLOWS - ALLOWABLE CAPACITIES**

(EACH HALF OF STREET)



**Figure 7**

**REDUCTION FACTORS FOR ALLOWABLE GUTTER CAPACITY**



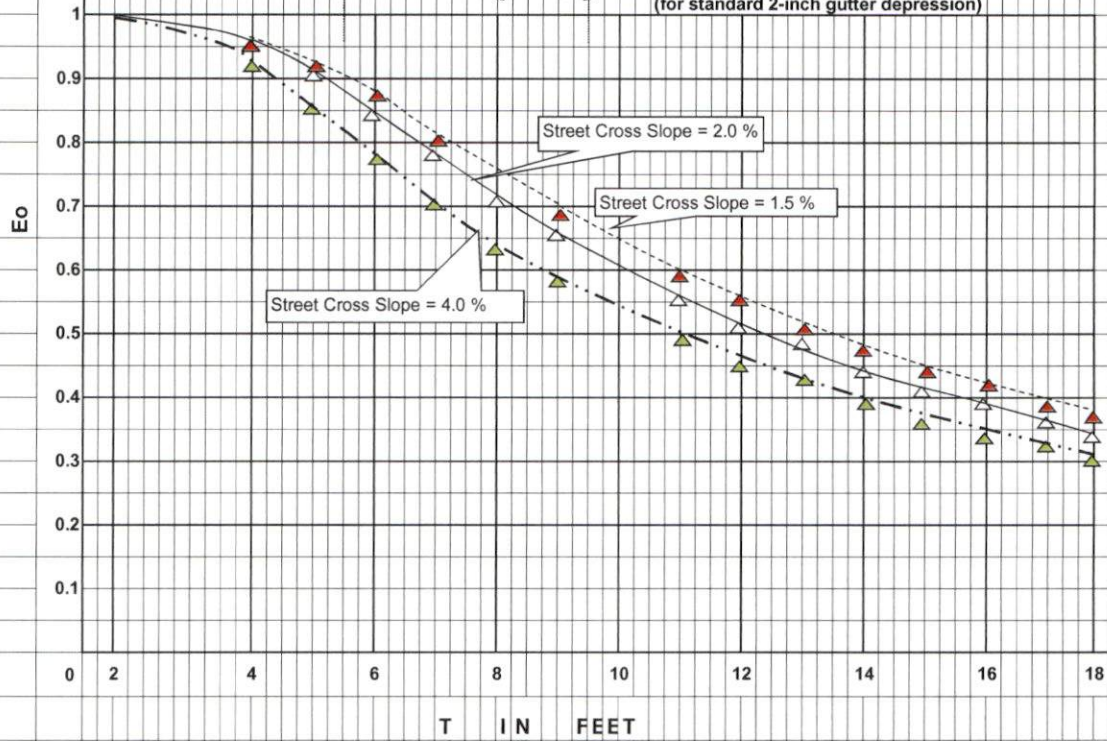
Reduction Factors have been established in order to account for flow obstructions due parked cars and moving vehicles, and to reduce flow velocities to 7 fps in the initial storm and 10 fps in the major storm, and to contain the flows in the available ROW.

**Figure 8**

**E IN FHWA EQUATION FOR COMPOSITE CROSS SLOPES**

$$Q = \frac{Q_s}{1 - E_o}$$

(for standard 2-inch gutter depression)



February, 2020

**Figure 9**  
**(1-E<sub>o</sub>) VALUES FROM FHWA EQUATION**

